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## Improving Yesterday's Subdivisions

The subdivision plan of developing a community, while overworked just now and thought by many to be a strictly modern scheme, is in reality quite an old stunt. The subdivisions of twenty or thirty years ago, planned and "improved" at the time in the same short-sighted manner that is seen in so much current work, are now settled parts of the community. By this time the houses have even taken on an old and worn appearance in the cases where successive owners have hesitated long before sending for the painter or the carpenter. The streets, considered fine in the day of horse and buggy traffic, have by now become mere hazards for the impatient motorist after years of pounding by heavy motor trucks. Water mains, gas mains, and sewers have been repaired and new service connections have been laid from time to time at the expense of tearing up and patching the pavements.

Now comes an era of rehabilitation of the property as values increase and new owners come on the scene. The street is torn up and repaved with a more modern pavement. And just after this hard paving has taken its traffic comes a sad situation. John Jones' house catches fire from an overheated furnace, and a life's savings have gone up in smoke. A leading tax-payer and his family have lost home and personal property. When the fire department arrived they found the water pressure too low, for encrustation had seriously reduced the carrying capacity of the water mains that were originally but half as large as they should have been.

The neighbors are up in arms. What if their own home should likewise burn? A petition is circulated, and the water department in due course sends out a gang and new and larger mains are laid. But facing the crew is a hard surface pavement, newly laid, and this must be broken into at some expense. Then, after the fill is compacted a patch must be put in over the trench, and the new street that cost the taxpayers so much money is never the same.

That is a situation that faces almost every American city that has grown at all during the past generation. There is but one thing to do to ameliorate the condition. The board of public works should consult the water department at the onset of any paving program and determine the distribution equipment in existence. If inadequate, a new enlarged system should be arranged for, and installed before a yard of paving is laid. The property owners will be glad to obtain the better service even at the expense of an additional assessment. The problems of the water department will be simplified. The new street will never have to be broken into except for the repair of infrequent leaks, and will have a chance to serve out its full life for which the tax-payer has paid. In all, a little foresight will prove beneficial and profitable for all.

And the lessons of that old subdivision should be borne in mind when planning improvements in the new one of tomorrow.

## Need We Permit Grounding?

The eternal question of grounding electric distribution systems, telephone circuits, and radio circuits on the water pipes seems to crop up every year. Admittedly, stray currents from high tension systems, ordinary lighting circuits, and electric signal systems, when passed on to the water distribution system, lead to serious damage to the pipes, meters, and even to the structures served. The latter claim has been advanced in several cases where the origin of fires has been such that an electrically charged water pipe has been suspected. Admittedly electric currents must be grounded to complete the circuit and to protect the system against overloads arising from various possible causes. Before current action was instituted on the part of water departments, the natural tendency on the part of many a utility was to utilize the handy water pipe as the cheapest and best ground. Then came the recognition of the electrolysis theory of corrosion, and the modern water works engineer began to cast about for ways and means of protecting his distribution system against damaging currents, and to protect his department against damage suits that might arise.

Some communities have forbidden all ground connections except those of the radio and often of the telephone—two systems where the voltages are small enough to be generally considered negligible. Other communities have restricted such grounding to the main side of the meter. This works no hardship on the electric utility since the efficiency of such a ground is greater than the efficiency of a ground on the house side of the meter. Other communities have specified that a copper shunt wire be installed around the meter in order that grounded currents may be by-passed. Other communities make no restriction at all.

As long as grounded currents are harmful to the system, water works officials should unanimously forbid such grounding, and compel other utilities to maintain their own separate grounding systems, even though such grounding would cost them a little more money. Then to prevent harm to the pipes from picking up stray currents from the soil, coming from grounded circuits in the neighborhood, research should be extended and maintained until the perfect insulating joint be found, and until improved pipe materials be found, if possible, that will be even more resistive than those commonly in use today.

The water works engineer is in no way obligated to permit other utilities to make such use of his system, particularly when the use is admittedly detrimental.

# Providing Streets for Newly Promoted Community

## How Portions of a 250-mile System of Graded 30-foot Gravel Roads, in Realty Development, Were Built for Less Than $9,000.00 Per Mile Including Clearing and Grading

By FRANK W. SKINNER, C. E.
Consulting Engineer, New York City

To provide for beautiful and spacious country estates, luxurious summer residences, cottages, bungalows, great summer hotels, elaborate club houses with extensive and high class outdoor sports and recreations, several golf clubs, a polo field, a land locked yacht basin, a harbor for deep water freight and passenger ships, and to exploit the

Insley Excavator Grading on Highway Work

beauties of landscape forests, lake, hills, valleys and beaches within commuting distance of New York City, Boston, New Haven, Providence, and a large area of the richest and most populous parts of the east, there has been developed an improvement scheme for the outright construction of a city of 50,000 permanent residents and twice as many transient in a favored locality, cool in summer and moderate in winter, where there are unlimited ocean and inland lake advantages, and a beautiful terrain of great diversity.

About 9 miles of the eastern end of Long Island, consists of a 10,000-acre tract containing about 2,000 acres of large and small fresh water lakes, among hills and bluffs up to 200 feet above sea level, sandy beaches, fertil valleys, rolling upland, forest and meadow that have never before been improved to any considerable extent and, except for a very few scattered residences and fishermen's hamlets were uninhabited since the days, hundreds of years ago, when they were possessed by the Montauk and other tribes of peaceful, fishing and agricultural Indians.

Here, less than two years ago, the Montauk Beach Development Company, financed and officered by men of large resources and previous experience in the creation and operation of large scale successful Florida developments, started an intensive program for the rapid and continuous construction of a real city with civic center, industrial, commercial and residential sections, a park-like development, luxurious club houses, varied and extensive major recreation facilities. It is expected that this work in a very few years will have caused the expenditure of $50,000,000.-00. It will include the creation of a well systematized and coordinated community with the most modern and complete facilities for municipal, corporate, private and public needs, together with beautiful and attractive surroundings and special facilities for yachting, bathing, motoring, golf, polo, tennis, and other outdoor sports and avocations.

**Some Work Now Completed.** — Several million dollars have already been expended for materials, equipment and on preliminary and permanent constructions that have employed a force of more than 1,200 men and have already enabled one great hotel, an 18-hole golf course, polo field, and other facilities to be opened to the public.

When operations were commenced early last year the site was accessible by slow and infrequent trains on a branch of the Long Island Railroad and by very indifferent highways over and around the sandy hills to the lighthouse and fishing hamlet that were then the principal improvements of this area.

The development company immediately put a large force of engineers and surveyors at work on estimates, maps and designs, and located the principal features of construction. They purchased a large amount of high class standard construction equipment and put their own forces actively at work on some of the major improvements, while contracts for others have enabled

Grading with Fresno and Cletrac

more and wider construction to be constantly initiated and advanced.

**Unified Street System.**—To properly serve the civic, commercial, industrial, residential parts of the city the outlying building lots and estates, the club houses, hotels and recreation fields, there has been laid out a comprehensive unified system of about 250 miles of hard surface, 30-foot highways and

Discing and Fresno Work Done With Tractors on Subgrading Work

Spreading a Fill with Cletrac and Fresno

30 miles of bridle paths built on economic principles, according to the best standards and latest practice for duty, convenience, durability, and charming scenic effects of lake, valley, forest and ocean.

Although the elevation of the original surface varies from sea level to 200 feet above, a large portion of the area is high land and the roads in general approximately follow the contours with sweeping curves, connecting tangents, and a succession of meadow, lake, inland and ocean vistas, without involving any considerable amount of heavy grading.

**Soil Encountered.** — The soil fortunately is chiefly sand and loam with some gravel that involves few drainage difficulties, affords an excellent and trustworthy roadbed and is easily excavated and surfaced.

At the beginning of operations short sections of macadamized road were carefully built adjacent to the railroad terminal, connecting it and the different warehouses, shops, and equipment yards on the site of the first and most important constructions, so as to facilitate the delivery and distribution of materials and heavy plant.

Little or no rock is encountered and as in general the soil is loose, dry sand, gravel, and loam, moderate slopes and no bridges are required, a standard type of gravel roadway was adopted that furnishes a smooth, durable hard surface adequate for ordinary municipal and suburban requirements for satisfactory automobile service. Little or no heavy grading is required and drainage is provided for a small amount of side ditches, and by culverts made of 12-inch galvanized iron Armco pipe, which more than 6000 ft. have already been used.

Up to date about 40 miles of the highway has been constructed and put in service, and the mileage will be increased by large annual quantities, keeping construction in advance of the prospective requirements.

**Subgrading.**—A small amount of excavation from 6 to 12 feet in depth has been made by a gasoline-driven Insley excavator equipped to work as a shovel, a mixer, a skimmer, or a drag line and here usually attended by three or four, 4-yard dump trucks that haul the material only a few hundred feet, and handled a maximum of about 350 yards of spoil per day. The excavator being equipped with extra large crawlers worked advantageously on rough and soft ground and could operate if necessary in some of the swampy places encountered. The total cost of operation was about $30.00 per day and it was considered that it was equivalent to 50 pick and shovel men.

Pile Driving for Pier and Bridge Work

**Cleaning and Grubbing.**—The 50-foot right-of-way was cleared, grubbed and burned, and 30 feet of it was loosed with plows and disc harrows which together with a large number of scrapers, graders, finishing machines, rollers and oil sprinkler were hauled chiefly by some of the fleet of 24 Cletracs installed for this development. Their weight of about 4,000 lbs. being distributed on broad and long track surfaces of the crawlers enabled them to haul 8-foot scrapers and move 200 yards of material 300 feet up grade in one 9-hour shift with a consumption of two gallons of gasoline and one quart of oil.

**Embankment.**—They were also able to build embankments over deep swamp when a 2 or 3-foot layer of brush forming a loose mattress had been spread over the surface and sufficed to float the tractor, scraper and fill.

It was therefore considered in view of the wide distribution and great variety of services they were required to perform in roadbuilding, and for other construction purposes, that the installation of a large number of these comparatively small handy units was more advantageous than it would have been to employ fewer and larger units. Sand and gravel for all construction purposes were excavated by a steam shovel and hauled in dump cars by two 5-ton Brookville locomotives with Fordson tractors driven that delivered the material to the washing and screen-

Sand Screening Plant on the Beach

Shovel Making the Heaviest Cut for Roadway

ing plant where the graded gravel was stored in three 70-ton Butler steel bins or in surface heaps later reclaimed by a clam shell bucket.

**Hauling the Gravel.**—From storage the gravel was hauled to the road by trucks and by Linn tractors sometimes pulling trailers and often equipped with a 5-yard dump body that, having a roadspeed of 9 miles per hour, did rapid and satisfactory work. These tractors weighing 7½ tons hauled gross loads up to 60 tons on the level and, with 5-yard loads, mounted without difficulty, all grades encountered. They are of the heavy duty track-laying type with special crawler lags automatically adjusting themselves to the uneven ground surface and thus producing very efficient traction. These tractors hauled most of the 10,000 yards embankment required for a large causeway built in water a foot or more in depth.

With them were used two 6-ton Low Drag Trailmobiles that were loaded with very little elevation of material and were considered 50% more efficient than ordinary trucks.

**Service Trenches.**—Where the roads were crossed by mains of the water supply and distribution system the latter were laid in trenches 4 to 5 feet deep that were dug across the right-of-way by a Barber-Green trencher making a vertical-side excavation 16 or 18 inches wide that generally stood up without sheeting until the pipe was laid and tested, and as it was operated at 5 to 10 linear feet per minute and the pipe-laying was speeded up by the use of Universal Cast Iron pipes joined by tension bolts that eliminated poured or calked joints, the interruption to road construction was almost or quite negligible.

## County Highway Officials' Division Meeting

The Executive Committee of the newly organized County Highway Officials' Division of the American Road Builders' Association held its first meeting recently in the office of President Wasser, Jersey City, N. J.; and in addition to formulating by-laws to be presented to the board of directors at its next meeting, mapped out a program for the ensuing year.

Many letters relative to organization and activities from enthusiastic members from different parts of the United States were read and considered.

A part of the plan of organization is to have county contact men, or a representative of the Division, appointed from each county who would serve as the contact between the Division and the county and who would be the official delegate to the annual convention.

It was found that New Jersey was the first state to complete the appoint ment of all its contact men.

In some states there is already a county organization but where there is no such organization it was urged, without official action at this time, that the contact men of the same state should organize into state units.

In addition to the consideration of the appointment of county contact men several standards committees were created and chairmen appointed.

Eight committees were appointed at this time but other committees will be added from time to time. The committees and their chairmen are as follows:

1. Committee on Surveys and Planning; Chairman, Stanley Abel;
2. Committee on County Highway Construction; Chairman, Chas. E. Grubb;
3. Committee on Rural County Highway Maintenance; Chairman, E. B. Wilkes;
4. Committee on Urban County Highway Maintenance; Chairman, Geo. A. Quinlan;
5. Committee on County Highway Legislation; Chairman, H. B. Keasbey;
6. Committee on County Administration; Chairman, Chas. A. Browne;
7. Committee on Construction and Maintenance Equipment; Chairman, E. L. Gates;
8. Committee on County Highway Finance; Chairman, John McHugh.

The reports of the committee will form the basis of a paper that is to be presented by the chairman, or someone appointed to represent the committee on County Highway Officials' Day at the Convention and Road Show of the American Road Builders' Association, which will be held in Cleveland, Ohio, January 9-13, 1928.

There will be a meeting of all committees Monday, January 9, at the Hollenden Hotel, Cleveland, for the purpose of making addenda to the reports and for formulating plans for the next year.

By designating County Highway Officials' Day at the Convention and Road Show the county officials are given benefits of the reports and discussions by officials having similar problems. On County Officials' Day all activities will be handled by county officials and the program will be made for their benefits.

Each year at the Convention and Road Show the highway officials and engineers present papers on the latest improved methods and the manufacturers bring out the most up-to-date and efficient materials and machinery; therefore all governing highway boards are urged to send a large representation to the Convention and Road Show, for it is certain that the knowledge gained by the contact with the latest ideas in highway work will create savings in the road expenditures that will many times offset the expense of their representatives to the Convention.

## Labor Saving Method of Handling Paving Brick

In constructing a brick pavement last fall on South Main St., Rockford, Ill., the contractor, A. E. Rutledge, used a method for handling the brick that required six fewer men for the operation and is stated to have effected a saving of about 10 ct. per square yard. The method also done away with the necessity of piling the brick on the sidewalk on either side of the street. The method of handling the brick was very simple. The contractor merely built some wooden crates, high enough to hold five rows of brick and wide enough to hold ten brick to each row. The brick were packed in these crates at the cars, hauled to the job on trucks, and placed in position for the brick droppers, the latter taking the brick directly from the crates. The pavement is 50 ft. wide and laid on a 7-in. concrete base and a 1½-in. sand cushion.

# New 20-In. Well at Benson, Minn.

## How Supply for Municipal City Water Light, Heat and Power Plant Was Increased from 165 Gals. per Minute to 520

By THEO. K. LEE
Superintendent and City Engineer, Benson, Minn.

The city of Benson is a prosperous little town of 2,500 population situated in northwest central part of Minnesota. It has for several years been somewhat handicapped by an inadequate water supply, the supply being obtained from two 8-in. wells 165 ft. deep.

The first experience in a shortage of water was in 1913. Our pumping equipment at that time consisted of a motor driven triplex pump and a duplex steam pump. The very best results we could obtain in pumping water with these pumps was 55 gal. per minute with a 26-in. vacuum. A thorough investigation of the water condition and the possibilities of an increased production from these wells was made and the advisability of installing an air lift system for pumping the water from the wells was taken under consideration. Air lift systems were carefully investigated by visiting towns which had such a system. Action was taken on the proposition and two Ingersol-Rand air compressors were purchased, one 10x10 in. motor driven and one 10x10 in. steam driven. These were installed and a Harris air lift pump put into the wells. The result was that the supply was increased from 55 gal. per minute to 240. This system pumps the water direct into a concrete reservoir, from where it is boosted by a centrifugal pump of 600 gal. per minute capacity into an elevated tank.

This system of pumping and our two 8-in. wells have served the water requirements of the city very well up till the last year. The constantly growing demand for more water increasing, the situation reached a critical point in the summer of 1926, when at times it was impossible to keep up the water requirements and restrictions in the use of water had to be served on the water consuming patrons in order to maintain a somewhat adequate water supply in case of fire. The amount of water obtained at this time was only 165 gal. per minute.

Considering the poor production of the city wells the city council and water and light commissioners, upon the recommendation of the city engineer, decided to drill a new well of a diameter of 20 in. and the engineer was instructed to prepare plans and specifications for such a well. Bids for the construction of the well were advertised and contract was awarded to the McCarthy Well Co. of St. Paul, Minn.

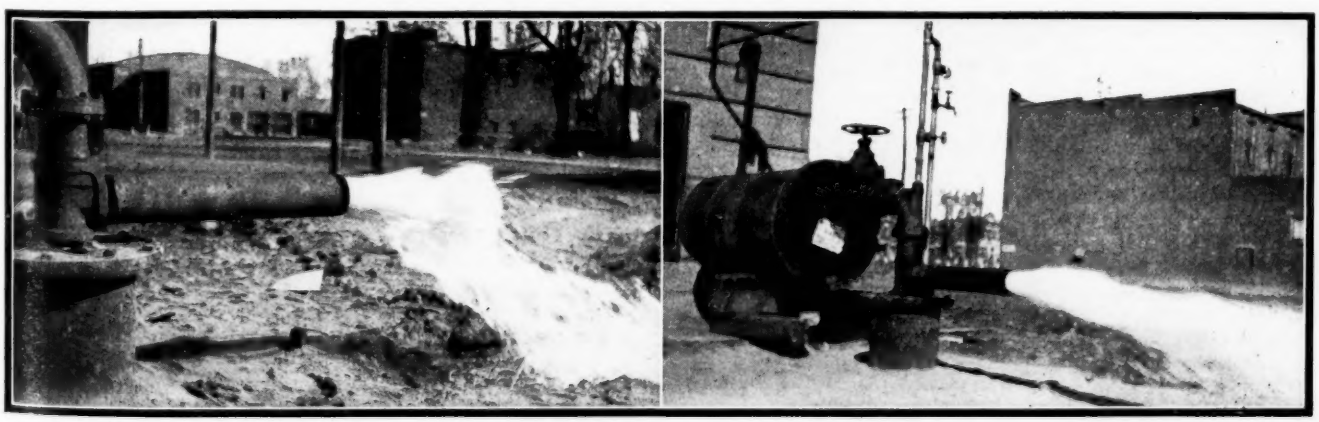
The log of the two 8-in. wells indicated that the water bearing sand was of a very fine quality commencing at a depth of 145 ft. from the surface. This water bearing sand formation being 20 ft. in thickness the contractors used a very fine screen, brass type, 20 ft. in length. It was decided to lower the 20-in. well casing to approximately a depth of 145 ft., or until the water bearing sand was encountered; then a Cater Armco iron screen 20 ft. in length with large openings was to be lowered through the water bearing sand formation and gravel fed into the annular space between the screen and outer casing. The fine sand was then to be bailed out and as this was being done the weight of the screen and gravel would force the screen to its final position.

Work on the construction of the well was commenced Oct. 25th, 1926. When the 20-in. casing had been lowered to a depth of 120 ft. some fine water bearing sand was struck; this turned into a formation of sand, gravel and rock which continued to a depth of 141 ft. The 20-in. casing was lowered to a depth of 135 ft. A formal agreement with the engineer and the well company having been made to the effect that if they should encounter any water bearing formation of any quantity this should be taken into the well, the company, without any extra expense to the city, proceeded to punch the 20-in. casing between 121 and 129 ft., this being where the coarse gravel and rock formation was located. This punching done they proceeded with the lowering of the 8-in. screen. An additional length of 10 ft. was added to the 20-ft. screen. This was necessary in order to go to the bottom of the water bearing sand. It also was found that the sand was of such a very coarse quality, containing coarse gravel and rock, it was not necessary to gravel pack the well as first contemplated.

Upon the completion of this work the company installed their test pump, the city having a guarantee of at least 400 gal. per minute in their contract, and proceeded to clear out the well and make tests. Several tests were made with a substantial increase every time, one test giving a production volume of 450 g.p.m. In making a final test to obtain 500 gal. from the well something unforseen happened, the sand, gravel and rock came up from the bottom of the 20-in. casing and completely filled up the inside of the screen. The company removed the test pump and cleaned out the sand and set a 12-in. screen on top of the 8-in., this being so constructed that no recurrence of this nature would happen in the future. The test pump was again put into the well, this time with the result that we obtained 520 gal. per minute with the well steadily increasing.

For the present we will use our air lift system for pumping this new well, as we can use it very efficiently in view of the fact that we have very little draw down, considering the amount of water we are taking out, in comparison with the two old wells. We are, therefore, able to get nearly five times as much water from the new well as compared with either one of the two old wells, and with the same air lift system.

I think this is a remarkable well construction in view of the fact that this new well is at the same depth and water is taken from the same formation as the old wells, only 65 ft. distant, thereby demonstrating that the water exists in the formation but that the construction of the well is of such nature as to get the maximum quantity of water from this formation which exists, and in accordance with which our other two wells were not constructed.



Flow from the New 20-in. Well at Benson, Minn.

# Shade Trees for Towns and Cities

## How a Municipality Can Assure Good Shade Trees in Street and Park as Told in Kansas Municipalities

By ALFRED MACDONALD
Director of Parks and Forestry, Wichita, Kansas

There is no asset a city can possess which will add more to its beauty and attractiveness than well cared for shade trees growing upon the city's streets. But on the other hand there is no feature which will so indicate the lack of civic pride in a city than the presence of broken and dying and poorly cared for shade trees.

The planting of a shade tree in a city parking is a public improvement which costs less than almost any other public improvement which can be made. Ten to fifteen dollars for each fifty foot building site is the average cost of tree planting. Unlike most public improvements such as pavement and sidewalks, which depreciate in value as time goes on, shade trees increase in value and become finer and more beautiful and give a greater service as they grow older.

Shade trees add to the value of property. Shade trees make a city a healthier place in which to live. But perhaps the greatest value of shade trees is in beautifying our cities and ameliorating the intense heat of our hot summer months.

The culture of trees in a city and particularly the culture of trees growing in the city parking spaces and on the city streets is becoming more and more difficult. Trees grow naturally in the forest. In the forest trees protect one another from winds and storms, but a tree growing on a city street is isolated and alone and at the mercy of the elements. Where trees grow naturally in the forest their roots are protected by leaf litter and humus, but trees growing on the city streets have their roots cut off from their supply of moisture by hard pavements and sidewalks. In the forest, where trees grow naturally, they are protected from insect pests by birds and by the natural parasites of insects, but a tree on a city street is almost without such protection.

Many other unnatural conditions retard the growth of city shade trees. Storm water sewers carry off the water which would otherwise sink into the ground and become available to the tree's roots. Clearance for overhead wires requires the removal of limbs and branches. Gas pipes often leak with a consequent death of the adjacent shade trees. Insect pests and diseases, many of them brought from European and Asiatic countries, are contributing to the death and decline of numbers of shade trees each year.

And so it is that trees in a city and especially trees growing upon a city street, are living a most unnatural and artificial life, and the unnatural and artificial conditions which affect tree growth are becoming more and more difficult as time goes on.

If we are to grow trees successfully in our cities and upon our city streets we must therefore give them especially good care and attention.

**City Forestry Department.**—The logical way to handle the shade tree situation in a city is to have a city officer or a city department charged with the responsibility for the care of the city's trees. In Wichita the forestry work is under the jurisdiction of the board of park commissioners and the director of parks acts as city forester.

The organization of forestry work connected with park activities is a perfectly logical arrangement. The park executive should be the champion of those things which make for a city beautiful, and his part should be especially the beautifying of the city by the promotion of the planting of trees and shrubs. There is no way that the park executive can better take this doctrine of the city beautiful to the very door of every resident of his city than by the planting and care of shade trees on the city streets. There is no way that a park executive can more closely come in sympathetic contact with a man or woman in his city than by the care of a declining shade tree at this man or woman's own home. By the planting and care of the shade trees of his city the park executive is really making a park in every citizen's door-yard.

The only way that a city can expect to have its street shade trees systematically planted and uniformly trimmed and cared for is by having such a city forestry department. Where no such regulation for the planting and care of shade trees exists, and where the selection of trees for street planting and their care is left to the individual property owner, the city's parkings generally represent a conglomeration of different species of trees, many of which are undesirable, planted in a haphazard manner. But in those cities where the responsibility for the care of the shade trees is placed on a city forestry department, we should find desirable species of trees planted at uniform distances apart and the trees on the city's streets trimmed to uniform height.

Many states have passed laws to enable cities to establish city forestry departments. Massachusetts has its tree warden law, passed in 1898, requiring every town and city in the state to elect an officer annually who shall have charge of the shade trees. The laws of New Jersey and Pennsylvania provide for the establishment of shade tree commissions in towns and cities. The statutes of the state of Kansas referring to cities of the first and second class place the responsibility for the care of the city's shade trees on the park officials.

**Theory of Municipal Control.**—The theory of the legislation with which I am familiar, providing for municipal shade trees growing in the city parkings and within the limits of the public streets to be public property. This is as it should be. Shade trees growing in the parkings are of interest and benefit, not only to the residents in front of whose premises they stand, but they benefit every man, woman, and child who uses the street. The entire community gets the benefit of shade trees. All shade trees growing within the limits of the public streets should be absolutely under the control of the city.

The financing of the pruning and care of the shade trees on the streets and in the parkings should be at the expense of the municipality, and the funds should be raised by tax levy. It is right and proper for the individual to pay for the planting of the trees in front of his home, as he pays for pavement, but the pruning, and other care of the shade trees after they are set out should be an obligation against the city at large, for every one in the city gets the benefit from these trees.

An individual should not be permitted to remove a fine tree in the parking in front of his residence just because he happens to be short of firewood and wishes the wood for fuel. The removal of such a tree may destroy the beauty of the entire street.

**Forestry Department.**—In starting such forestry work the first step should be the passage of proper ordinances. These ordinances should place the responsibility for the pruning and removal of the public shade trees in the hands of the forestry department, and should prohibit the trimming or treating of trees in the parkings by any other person, except with the permission of the forestry department. Numbers of trees are killed each year as a result of improper trimming and treatment by men who represent themselves to be competent tree men, but who have little knowledge of tree culture. The requirement of making it necessary for any one trimming parking trees to obtain a permit will control the butchering of shade trees by incompetent persons. Where permits are issued for tree removal, the person taking out the

permit should be required to grub out the stump. Nothing is more unsightly than a row of stumps representing the remains of once beautiful shade trees. The ordinances should also give the forester authority to enter private property and correct insect infestations, or remove dead or dangerous trees and charge the cost of the work to the property.

Tree trimming should be handled so that a crew of men is placed in a section of the city, starting on a certain street and trimming and repairing every tree on that street as the work progresses. The cross streets should be trimmed half-way down the block. When a street is worked out the men should then turn on the next street and work this street in the same manner. A crew of five men and a foreman with a truck or team to haul away the brush and wood is a practical crew to use on tree trimming. The tree trimming should be so organized that a certain portion of the city can be covered each year, and continue so that every four or five years a trimming crew will be back to the place they covered four or five years before. This will insure all the trees in the city being systematically trimmed once every four or five years. The average tree requires trimming once every four or five years.

Our experience has been that the best season for trimming is from May until January. Maple trees and certain other species bleed if trimmed between January and May. I believe that it makes little difference as to which month tree trimming is done providing the trees that bleed are not trimmed in the early winter and late spring. That is contrary to the general theory. Many people believe that trees should be trimmed only in the winter. I have been in this work for about thirteen years and have supervised the trimming of nearly a million shade trees. Our experience has been that providing you don't trim the trees that bleed, such as maple, between January and May, you can trim trees at any time of the year without dangerous results.

During the period that tree trimming can not be effectively done, namely between January and May, tree removal can be most efficiently handled. Money spent removing trees during the winter will result in much more work being done than if the same expenditure is made during the summer months. The forestry work can therefore be so organized that a constant number of men may be given steady employment twelve months in the year.

**Tree Planting.**—The city forestry service is not complete without some arrangement for providing for the planting of shade trees on the city's streets. A forestry department can best justify its existence over a period of years by promoting the planting of shade trees, for street tree planting under the regulation of a city forestry department will insure the growth of the proper kinds of trees and will provide for the uniform planting of desirable species, especially in the new additions of the city. One cannot visit the city of Washington without being impressed by its beautiful shade trees. The street trees of Washington have been under strict municipal regulation for years. Certain streets are planted uniformly with a certain kind of tree, spaced at uniform distances apart.

In many cities provision is made for the planting of shade trees and levying a special assessment against the abutting property to defray the expense of the work. This is especially desirable in the case of new additions. City planning commissions can promote the proper planting of shade trees in new subdivisions by encouraging the planting of shade trees before the plat is accepted. The properly regulated planting of shade trees in new additions will insure desirable trees, all of a certain age, and will reduce the future expenditure for tree trimming and tree removal by prohibiting the planting of short-lived trees and other trees which are not adapted to street planting.

A forestry department may plant the trees with their own forces or have the work done by a nurseryman at a contract price. Many cities have a municipal nursery where a city's shade trees and shrubs for park planting are grown. Where a city has such a nursery the forestry department can perhaps give better service by handling the tree planting with its own forces.

The critical period for a newly-planted tree is the summer following the setting of the tree. In Wichita we have our municipal nurseries and we grow practically every shrub and plant we use in the parks and many of the trees we use on the streets with our own men in the municipal nurseries. In Kansas provision must be made for watering newly-planted trees the first summer after they are planted. If a tree lives through the first summer its chances of continuing to survive are very good. Where trees are planted by individuals often less than 50 per cent live through the first year. This is generally due to lack of proper care. Here a city forestry department can help greatly. After the trees have been planted the forestry department should send out directions at the proper time concerning the watering, cultivation, and necessary care of the newly-planted trees. The department should make inspections at intervals during the summer in order to call the attention of residents to such care as the young trees require.

**Species Suitable for Street Planting.**—Because of the adverse conditions to which a city shade tree is subjected, there are but few species which are sufficiently hardy to grow well on a city street. In Wichita, the summer following the setting of trees for the property owners, we have our inspector make several inspections of the young trees we have set out, generally three or four at intervals during the summer. Where they are not being properly watered and not properly cared for we send post card notices to the residents informing them of the treatment the tree needs and then we follow it up to see if they have followed the instructions.

An excellent tree for street planting in Kansas is the American Elm—the most beautiful tree that grows. Its worst pest is the borer, but young trees that are well-watered and cultivated are not often seriously injured by these pests. Another excellent tree, which has not been planted to the extent that it deserves is the Hackberry. The Hackberry is hardy, it makes a vigorous growth, and it is practically free from insect pests. The Pin Oak makes a long-lived, beautiful tree when planted on a city street.

The Honey Locust, and Ailanthus or Paradise tree are sometimes planted in special situations.

There are some trees which should be condemned for street planting. The Cottonwood is one of the poorest trees for street planting. The wood is soft and brittle, the pistillate trees are a nuisance because of their habit of shedding "cotton." Cottonwood roots travel long distances in search for water, and clog sewers and water pipes. The Cottonwood grows too large for planting on a modern city street. An old Cottonwood on a city street may be a liability rather than an asset.

However there is this to say of our Cottonwoods in our southwestern cities—they were a God-send to the early pioneers who left their Eastern homes in a wooded country and who yearned for the protection of a tree against the blazing sun of the open prairie. The Cottonwood grew wild along our Kansas streams and was the one tree that was absolutely sure to grow.

The Box Elder is open to the same objections as the Cottonwood. In addition, it is the host of more insect pests than any other tree, and should not be planted on a city street.

The planting of soft Maples is a short-sighted policy in our southwestern cities, for they are short-lived and when they start to decline there is practically nothing that can be done to rejuvenate them. And, contrary to the general belief, the growth of the soft Maple in our southwestern cities is no more rapid than the growth of the American Elm under favorable conditions.

**Insect Control.**—In many cities, especially those of the north and east, the efforts of city forestry departments are concerned largely with the control of noxious insects. Where such a condition prevails all the trees and shrubs in the city may be jeopardized, and it is certainly to the public interest to have all infested trees sprayed or otherwise treated. In many cities the expense of spraying and treating street

and parking trees is financed by a tax levy. The expense of spraying and treating trees on private property is charged against the property as a special assessment. Where any noxious shade tree insect makes its appearance it should be handled vigorously and at once by the city forestry department. Hundreds of thousands of trees have been destroyed in New England by the Gypsy Moth and other pests which could have been easily controlled had vigorous measures been taken when they first appeared.

Such insect control in Kansas may also be carried on in cooperation with the State Entomological Commission. I worked on the Gypsy Moth work in New England a number of years ago and I have seen there in the middle of the summer, in Massachusetts, acre after acre of trees just as far as one could see in the forest absolutely stripped of their foliage so that they were just as bare and brown as in the winter.

**Relations With Utilities.**—One of the most perplexing and sometimes the most disagreeable problem a city forester has to contend with is his relation with the utilities, especially with the electric companies. In many cities the electric companies have lost the good-will of the public by their high-handed slaughter of shade trees to get clearance for their wires. It is often hard to decide where the line is which separates the utilities' rights in securing such wire clearance, and the rights of the property owner in his shade trees.

There are three interests involved here. There is the interest of the resident in the trees in front of his premises, and he is naturally concerned because he does not want his trees mutilated. There is the interest of the utility, which should not be required to go to a prohibitive expense to set poles that are taller than necessary or to do other unnecessary, expensive construction work. There is a third and perhaps the most important interest, namely the interest of the people who are receiving service from the wires, and whose service should not be interrupted because of tree limbs short-circuiting the wires. The forester is faced on one hand with a situation that if the wires are not cleared numbers of homes may be without lights at every storm. On the other hand if the wires are given the clearance the utilities request, it will mean the mutilation of valuable shade trees.

No general permits should be issued to utilities for tree trimming. The best interests of all are served by having the work done by employees of the utilities, but done under the supervision of a competent representative of the city forestry department. The utility for whom such trimming is done should reimburse the department for the services of this employee. My experience has been that the utilities are glad to have such an arrangement, for if the residents have confidence in the forestry department they will permit the work to be done under the supervision of a representative of the forestry department and thus save time-consuming arguments between the resident and their employees.

**Private Work.**—It is a perfectly logical function of a city department to enter private premises and control noxious insects and diseases on shade trees, for when all the trees and shrubs in a city are jeopardized by such pests, it is certainly within the police powers of cities to control such conditions. In Wichita we have one man who spends practically all of his time with the electric company supervising the trimming, and at the same time other men who work with him, and the electric company pays for his services. Such work may be termed "Private Work." Certain citizens often request other private work to be done by the forestry department such as tree trimming, tree removal, and tree repair. When such work is done by the forestry department it may result in a source of revenue to the department and give real forestry service to the residents of the city. There are other sources of revenue which will help defray some of the expense of the forestry work. For example, the wood resulting from tree trimming and tree removal may be profitably sold. The cutting and sale of wood also gives the employees of the department work during inclement weather and permits the department to keep the men on during such periods they would not otherwise work.

**Educational Work.**—A city forestry department should keep the residents of the city constantly informed as to shade tree conditions. I remember one year in Wichita we sold more than $3,600 worth of wood that resulted from free removal and cutting on the streets. This is especially necessary in the case of the introduction of insect pests or tree diseases. Such information may be given out by newspaper publicity, by talks before civic clubs and improvement associations, and by special publications. The inspiring of the proper interest in shade trees and their care by educational methods will do much to popularize the work of the city forestry department.

Much can also be done through the children in the public schools, with Boy Scouts and similar organizations, Arbor Day programs, tree study in connection with nature study courses, the planting of shade trees on school grounds, the delegation of certain groups of children to care for school trees, all stimulate a greater interest in the city beautiful and especially in the appreciation of shade trees. The pupils of public school age take home to their parents the interesting things they learn in their school courses.

When the forestry and park work was reorganized in Wichita six years ago, there was very little literature available which concerned shade tree care and home landscape for our section of the country. Realizing the need of such information we published a book on the landscaping of home grounds and shade tree care. We also had several pamphlets published which were reprints of certain portions of this book. The book is sold at cost ($1.35) and the pamphlets are distributed at a nominal price.

**Cost of Forestry Work.**—I can best advise as to the expense of city forestry work by outlining the organization of the work in Wichita and the amount of money required to finance it.

Wichita has nearly one hundred thousand shade trees, more than the average city of its size. Many trees were planted by the early settlers who came to Kansas more than a generation ago. When the forestry work was started six years ago there were thousands of trees on our streets in a most wretched condition.

Receipts and expenditures for 1925 were as follows:

RECEIPTS

| | |
|---|---|
| Appropriation | $19,911.90 |
| Receipts from Private Work | 6,576.92 |
| Receipts from Tree Planting | 1,406.31 |
| Receipts from Wood Sales | 1,188.60 |
| Total Receipts | $29,083.73 |
| Expenditures | $27,362.81 |
| Balance January 1, 1926 | $ 1,720.92 |

During the period covered by this report the forestry division of the Board of Park Commissioners did the following work:

| | |
|---|---|
| Street Trees Trimmed | 15,000 |
| Street Trees Sprayed and Treated | 2,400 |
| Street Trees Removed | 1,100 |
| Street Trees Planted | 787 |

In addition to the inspection of the young trees planted by the department, numbers of inspections were made of trees on private property on request from residents.

**Association With Other Work.**—In Wichita the park, forestry and recreation work is all under the Board of Park Commissioners. Six years ago Wichita started on a systematic park, forestry and recreation program. We now have 17 parks and playgrounds, aggregating more than 500 acres. We have ten miles of park drives, and our recreation facilities include a municipal golf course, a large municipal swimming pool, five neighborhood pools, picnic grounds, aviary and zoo, and out-door moving picture and playground equipment. In addition to this work we are landscaping the school grounds in cooperation with the Board of Education.

City forestry work can become one of the most popular works that a city department can do. Every one in the city is interested in the trees of the city. There is nothing that will add more to the beauty and attractiveness than well-cared for shade trees on the city's streets.

# Filter Plants of Low Cost of Construction and Operation

## Description of Steelton and Denver Installations With Observations on Their Operation Given in Paper Presented at 9th Texas Water Works Short School

By J. H. FUERTES
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Waters which are habitually clear, and in which occasional turbidity is caused by coarse particles that readily settle out, can be purified without trouble by filtration. Other waters containing clay in large amounts require much more thorough preparation before they can be filtered.

It may be seen, therefore, that final cost of purification of such waters will be the sum of the cost of preparatory treatment and the cost of subsequent treatment, and that the most economical plant will be that one in which this sum will be least.

**Conditions at Harrisburg, Penn.**—It was found at the outset that the Susquehanna River water at Harrisburg, could not be handled, continuously, without preparatory treatment. The investigations covered plain sedimentation (ranging from a few minutes to several days), coagulation and subsidence through a wide range of turbidities with varying doses of coagulants, and with different periods of time allowed for preliminary coagulation and subsequent sudsidence.

Investigations on removal by straining, with or without the use of a coagulant, included rapid filters and beds containing sand of different sizes, as well as sponges and other absorbent material.

With the addition of a coagulant to help clarify the water, it was found possible, by subsidence for periods of less than 24 hours to remove all the small particles of coagulated clay. If a shorter period of subsidence were used, the coagulated particles would be carried out in the effluent from the settling tanks in amounts too great to allow of its application upon slow sand filters, for the reason that the clogging value of the coagulated clay was equivalent to the non-coagulated turbidity in a much higher amount and would, consequently, clog the surface of the filters and put them out of service quickly.

A non-coagulated subsidence of 48 hours would generally give an effluent that could be satisfactorily applied to mechanical filters, although slow filters would not, during the periods of high turbidity, give satisfactory results with this period of subsidence.

Twenty-four hours subsidence of the continuous plan, with a coagulant, gave an effluent that could be rendered suitably clear to apply to either slow or rapid filters.

Giving us, as it did, the data on which to estimate the cost of the works for handling different characteristics and amounts of turbidity we could readily determine for Harrisburg that the best plan would be a mechanical filter plant, on an island in the river, providing for eight hours subsidence and coagulation with mechanical filtration. This plant was subsequently built.

**The Steelton Filters.**—While this plant proved economical for Harrisburg, it could not be used at Steelton, Penn., whose intake is only two miles down the stream from, and on the same side of the river as Harrisburg, for the reason that no sites were available in which to locate the plant. The available small piece of ground had only room on it to build a reservoir, with a capacity probably less than three-quarters of a million gallons, and therefore, was altogether too small to consider it with a view to having a settling basin on the ground. As it was the only land available, we had to provide some means of handling the extremely variable and, at times very muddy Susquehanna River water.

The Steelton filter plant consisted of rapid and slow filters. The water, after subsidence to remove the heavy matter, passes into three roughing filters of the mechanical type, containing 5 ft. of river coal, crushed to an effective size of 1 m.m. with a uniformity co-efficient of 2.4 and not containing over 2 per cent particles that had passed through a screen having 30 meshes to the inch. After passing through the roughing filters, water is conducted to covered slow sand filters.

Omitting a description of the plant, which will be found in the Transactions of the American Society of Civil Engineers of Oct. 8th, 1909, it will be found that the Steelton Filter Plant is handling the water at about the smallest annual cost of any plant in this country of equal size, notwithstanding that it is quite small. For the past 19 years it has served to keep typhoid fever and all kinds of water borne diseases out of Steelton. Before the building of the plant they were of yearly occurrence.

The latest data received from Steelton show that for a 3.0 M. G. D. output the cost of operation, exclusive of interest and sinking fund charges, will be as follows:

| | | | |
|---|---|---|---|
| Alum | $0.39 | per M.G. | |
| Soda | 0.01 | per M.G. | |
| Chlorine | 0.05 | per M.G. | $0.45 |
| Labor for general operation and superintendence | | | $5.83 |
| Scraping, washing and resanding slow filters | $0.52 | per M.G. | |
| Power | 0.16 | per M.G. | |
| Administration | 0.10 | per M.G. | |
| Wash Water | 0.15 | per M.G. | $0.93 |
| | | | $7.21 |

It may be noted that the amount charged for labor of operation and superintendence is $5.83. This amount of labor is sufficient to operate a plant three times as big, or a charge of $1.94 per M. G. of water delivered. For comparison with larger plants, or as an indication of what a larger plant would do, this is a better figure to use, in which case the total cost of operation would be $3.32 per M. G. No figures are available from the city's books for determining the fixed charges.

**Dallas Plant, Low Head Filters.**—These filters are a very good illustration of what low head filters accomplish under conditions where pumping would otherwise be necessary. These filters were designed to work in conjunction with the large Turtle Creek Reservoirs. The first basin was made use of as a settling tank and the second as a filtered water reservoir. The filter plant was placed between the basins and because of the small amount of head required to operate them, the second basin operated at a water level only one foot to three feet below that formerly used. A large saving was effected by the avoiding of the pumping costs.

**The Denver Filter Plant.**—The new rapid filters which I built at Marston Lake, Denver, 64 M. G. D., accomplish three things which are unique in water purification. They operate under a very low head loss of 2.5 to 3.5 feet. They filter water at the rate of 175 million gallons per acre per day. They were built and operate at very low costs.

These results are obtained notwithstanding the fact that the Denver water is difficult to purify. It is somewhat turbid and contaminated, but its worst feature is that it contains an extremely high content of micro-organisms of the worst variety. These organisms are short lived and their decomposition gives rise to tastes and odors extreme at some seasons of the year. A further difficulty is that some of the organisms in their live state are free swimming

and have a remarkable tendency to penetrate and pass filters of the ordinary rapid type. They are so numerous that they would completely stop up slow filters. No means are now available for cleaning slow filters supplied with this water quickly enough to make this type of plant available.

Rapid filters were, therefore, adopted. In order to avoid pumping and to make possible every foot of head available for aeration, the filters work under a maximum head loss of 3½ ft., instead of the customary 10 ft. They also operate at the rate of 175 million gallons per acre per day. These two features are brought about by the use of coarse grained filtering material, 0.7 m. m. effective size, and 1.8 uniformity co-efficient. The filtering material is Susquehanna River anthracite coal, used in a bed 5-ft. deep. These two features make it susceptible of washing in these deep beds and in the coarse size in a manner which is not feasible with sand.

**Costs of Construction.**—The entire plant of 64 M. G. D. capacity was built with an intake for $2,000,000 all costs except land, included. The cost of the filter plant alone amounted to $26,000 per M. G. D.

As far as I know, this is one of the least expensive water purification plants for the treatment of a water as difficult to purify. This is notwithstanding the fact that certain local conditions of construction made the work cost ten per cent more than might usually be expected.

The usual cost for rapid filter plants at present prices, all costs included, is $30,000 to $40,000 per million gallons. Slow filter installations, operating at the usual rates, cost twice as much.

**Operating Costs.**—The costs of purifying water, are the lowest of any plant that I know about, treating water under comparable conditions. The operation cost is $5.75 per M. G. The total cost of purifying water, including interest, depreciation and all charges is $9.75 per M. G. This is based on the full rated capacity of the plant. Comparisons of operating costs with other plants are apt to be misleading, since costs vary so greatly with the character of the water treated, the size of the plant, local price conditions, and the wisdom and economy of administration. Some general comparisons of value may be made, however. I may say that the usual costs of purifying water under conditions at all comparable with those at Denver range from $11 to $18 per million gallons, all costs included, based on valuation at present prices, and with charges figured in a manner similar to that used for the Denver plant. I know of only one plant showing a cost as low as that at Denver. This is the plant at Montreal, Quebec, which was built after the findings of the double filtration plant at Steelton, Pennsylvania, previously mentioned herein.

Three particular items contribute to the economy at Denver: (1) Low labor cost. The plant is operated at the full rate by labor (total on payroll) of 2.0 man hours per million gallons. (2) Low doses of coagulants are used, the average for 1926 being

Alum, 0.64 grains per gallon
Lime, 0.27 grains per gallon

(3) Interest and depreciation charges based on the low installation cost given above, result in low fixed charges.

**Advantage of Denver Type Plant for Use in Conjunction With Existing Slow Filters.**—There are many existing slow filter plants which need increased capacity or will need it in the near future. The development of the plant at Steelton and the rapid filters of the Denver type opens the way for the enlargement of these plants at a small installation cost and provides a means for the purification of the water at a cost lower than can be obtained in any other way. The Denver filters are essentially the same type as the scrubbers used at Steelton and are especially adaptable for use as preliminary filters in advance of existing slow filter plants. Their use enables these filters to operate at rates of from 12 to 15 million gallons per acre per day as against the two to six M. G. A. D. now used. The purification effected by the double plant is of the highest character and offers a security furnished by no other method.

**Reason for Low Construction Cost of High Rate Double Plant.**—The rapid filters work at a 50 per cent higher rate than is customary in rapid filter plant practice, or that usually used in pre-filters. This means 50 per cent less filter area. The preliminary filters of the type in question are similar of operation and require less regulating and control apparatus than the usual mechanical filters. The slow filters working at rates three to five times as great as those usually used result in a small filter area and a low installation cost. Where existing slow filters are now in good condition, they can be adapted for use at high rates with a double plant by minor changes of piping and regulating apparatus and by a re-sizing of the sand. As compared to an abandonment of present slow filters, or a continuance of their operation as at present, supplementing them by filters of another or of the same type, the double plant as above considered, gives by far the lowest installation cost.

**Reasons for Low Operation Cost.**—First, the double plant of the type considered will use extremely low doses of alum. An example of this economy is offered by the comparison of the Harrisburg, and Steelton plants in Pennsylvania, both treating Susquehanna River water. The Steelton plant in addition gets Harrisburg's sewage. The plant at Harrisburg is a rapid filter plant of a type quite similar to many now in use. The Steelton plant is a double filter plant of the type under discussion here. The Steelton plant operates on an average dose of 0.18 grains per gallon of alum, whereas Harrisburg uses 0.5 grains per gallon. Seven-tenths (0.7) to one (1.0) grain is perhaps more usually experienced for similar waters. The saving here is one dollar ($1.00) per million gallons. Secondly, because of the low installation cost, the fixed charges will be correspondingly low.

I have recently made estimates for the enlargement of two rapid sand filter plants by the addition of preliminary high rate scrubbers and the increasing of the rate on the slow filters. These have exemplified to a marked degree the economy of the method. In preparation for one of these changes, test filters have been operated for almost a year and estimate designs prepared. It was found that the double filter plant would make a saving of several hundred thousand dollars in first cost over any other type of enlargement, and would net a saving in costs of purifying the water of $15,000 per year. The other plant is a similar case, though slightly smaller, and it was found that the saving by the use of double filters of the above mentioned type would be over $10,000 in construction cost and between $10,000 and $20,000 per year in operating costs. In both cases, it was found that the water would be purified by the double plant at a cost considerably under $10 per million gallons delivered, all costs included, with complete plant valued at present prices.

The fact that operating costs as low as these contemplated can be actually accomplished has not only been demonstrated by the experimental station at Denver and at Harrisburg (these were actual plants on a small scale), but also by the operation of the plant at Steelton. This plant has been in operation for nineteen years and, although a small plant, data from it is applicable in the establishment of costs of operation for a larger plant. Furthermore, the 64 M. G. plant recently built at Denver and which has been in operation for a year further corroborates the figures. This is a rapid plant only but it is the same type which is considered in this paper for use as preliminary filters for a double plant.

An added advantage of double filters is in their extreme reliability. As everyone knows, one of the greatest weaknesses of any plant for the purification of the public water supply is in the possibility of human failure. If everyone is on the job all the time and if everything is working as it should be, the plant will work all right, but these things do not always happen. Someone forgets, and somebody isn't there, or some part of the operation or equipment is out of order, and, consequently, some water gets by not properly purified. In recent years the application of chlorine has furnished a great safeguard of reliability, but chlorine machines, like other mechanical equip-

ment, are subject to periods of breakdown or to being shut off when no one is looking to save a few dollars.

Too much emphasis cannot be placed upon the necessity of absolute reliability. Double filters offer a reliability which is perhaps furnished by no other means. If from some reason the prefilters are out of service or do not stop the contamination, it is sure to be caught on the final filters and the chlorine offers a further protection which it is well to have.

These facts of reliabilty are not new ones. They have been appreciated for years and probably more so in Europe than in this country. The reason that double filters have not been more used in the past is that they have been more costly to build and operate than other types of purification plants. Now, however, with the fact established, as I believe it has been by the work above mentioned, that double filters can operate at rates so high and doses of coagulants so low that the costs of purifying water are actually below those usually obtained, the double filter plant seems very attractive.

# Water Works Reports

## What They Should Contain Outlined in Paper Presented Before Montana Section of American Water Works Association

By J. R. CORTESE
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Some water works superintendents, and occasionally city officials, may question the value of a water works report and doubt if its cost is money well spent. The answer to this question is simple. It depends upon the report.

One of my favorite indoor sports is to examine water works reports: the good ones being read with much interest and filed for frequent reference. My criticism of water works reports comes from reading them and, therefore, from the standpoint of the consumer, I am going to mention briefly a few features of reports that have made them especially interesting to me.

**Why Should a Report Be Made?**—A water plant is one of the chief assets of a city; in value it ranks well towards the top of all the city investments, whether owned by the city or company. The success and continued operation of all other industries, factories, etc., are dependent entirely upon the water works. The health, growth and prosperity of the city are entirely dependent upon the purity and cleanliness of its water supply. Its customers extend over the entire city; its commodity is standardized and is of one quality. If the city owns the enterprise, every citizen of the town is a stockholder and, therefore, a report to the public is due; and the public, further, has a right to demand a real water works report in keeping with the importance of the utility.

**Appearance of Report.**—Reports, like people, are often judged by appearances and, therefore, it should have an attractive cover and be of a good quality of paper and printing. Like a girl's skirt, it should be long enough to cover the subject, yet short enough to be interesting. The pictures accompanying a magazine article always produce a desire to read the article and photographs and cuts should be freely used to relieve the monotony in text statistics.

**What It Should Contain.**—A brief historical sketch, giving date of purchase or date when built and the present value of the property, is always of interest to new customers.

Statistics themselves are rarely read by the layman and these should be converted into graphical diagrams, which are understood at a glance.

A concise tabulation of operating costs, annual revenue, fuel costs, increase in number of connections, etc., shown both by figures and graphical charts, are always interesting and these should not cover more than a 10-year period, as old statistics are of little interest or value.

A population curve and water consumption curve are always well worth the making, as it shows what future provision for growth should be made.

A plain statement from health authorities regarding purity of water, with percentage of bacteria removed, with cuts or illustrations of bacterial comparison of raw water and treated water, is the best kind of advertising a report can obtain, for one must not forget that his business is selling water and the reports help sell the customer. People always like to know how their money is spent and a graphical diagram showing what part of a dollar goes for interest, labor, fuel and operation, is enlightening.

Illustrations showing losses by leaky faucets, bad plumbing and unregulated flush tanks for sewers, are helpful in bringing about reforms. Such illustrations are convincing in showing customers how much their own bills could be reduced by eliminating all wastage.

The reduced pumpage, fuel or power bills and increased revenue by a universal meter system are features that can and should be shown in every water works report, for even in this enlightened day we find a few communities who still sell, or rather give water away, without meter measurement. Our city of Livingston happens to be one of them, but we hope that within a year or two we will be metered.

The city, corporation or individual does not exist that can make a success of selling any commodity without measurement of the amount sold. The report should show, or account for, the loss between water delivered and water sold, and if this does not show a yearly improvement, something is radically wrong and needs correction.

A water works plant is never finished or completed and the needed extensions, betterments and improvements ought always to be prominently shown in a report, then there are no shocks or surprises. If bonds are needed there is nothing gained by concealing the fact. Show in the report why the improvements are needed and what advantages and results will be gained by them.

Every report ought to show the cost of delivering water per 1,000 gallons, including interest, depreciation, sinking fund reserves, etc. This information is not always known by the superintendent himself and when he figures it out, he will, in many towns, find that large users, railroads especially, are getting their water at less than its cost of production. When one glances at his own railroad and Pullman expenses these times, it causes the reflection that railroads ought to have sufficient funds available at least to pay for the cost of furnishing water. In these days of regulation of rates, one cardinal law acknowledged by all is that the rates of each utility, whether a water plant, light plant, or railroad, should be based on its value and cost of operation. The railroads or other large users are not institutions, with rates made because of their being a special aid or help to a town. Every report should show what the rates should be to earn this interest, depreciation and operating expenses.

**Value of a Report.**—A report is of much advertising value to the entire community, so much so that many commercial clubs are joining in the expense of printing and circulating water works reports. Every live water works superintendent knows the advertising value himself of getting out a good report. It places him in a favorable light before many other communities where opportunities for advancement exist.

The educational value is of greatest importance. It acts as an aid in getting bonds for needed improvements, as a basis for argument for equalizing rates or in securing a raise of rates.

**How Presented.**—A report to be of any value must be interesting, for if not interesting it will never be read. The author of the report or some water works official should personally present a resume of his report before every civic organization of the town, not omitting the women's clubs. These reports, thus presented, keep before the public a keen interest in their own utilities. Extracts from reports are desired by the local papers and should be given to them. Exchange your reports with the officials of other cities of your state.

The water works plant is the chief asset of the city, but the lack of general knowledge concerning it is a fault we can largely correct by getting out and presenting a genuinely interesting report. Whether it pays or not depends on the report and its presentation.

# Design of Pavements for Prolonged Use

## Utility of Paving Below Final Grade to Permit Resurfacing Discussed in Paper Presented Before Illinois Society of Engineers

By H. J. FIXMER
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The improved road or pavement is a structure designed to meet a simple requirement. The purpose of paving is to provide an efficient surface for the traffic expected to use it. This, in brief, is all a paving engineer has to provide for. This simple statement, however, must be analyzed, and the basic facts contributing to the happy result sought, must be defined, understood and realized in practice. Economic, local and political restrictions may interfere with an ideal solution, but the basic facts must be appreciated before preparing a design to meet the need of the traffic expected to use the highway.

The paving must accommodate the traffic. This means future traffic, which consists of present traffic with its expected growth, together with the additional traffic attracted to the improvement.

The volume, character and needs of the traffic must be planned for. This determines width of roadway, degree of smoothness, strength of structure, grade, alignment, freedom from repairs and maintenance and other details.

The paving must provide an efficient surface. This means a surface having traffic qualities, as non-slipperiness low crown, low traffic resistance, and the inherent ability to keep to a fixed contour and even surface, under the stress of excessive travel and impact.

**A Pavement is Judged by Its Surface.**—The measure of success of any pavement is the economic durability of its surface and incidentally its structure. An otherwise efficient wearing surface may be weakened and destroyed by an inadequate base or foundation. While the wearing surface and the base may be considered as a single structure (as concrete), it is better practice to consider them as separate components. The function of the base is to support and maintain the wearing surface to its original contour.

The function of the wearing surface is to afford a durable surface, generally smooth, free of noticeable undulations, resist wear, absorb impact and to some extent assist the base in carrying the imposed loads. In order that our pavements may keep pace with the increasing demands of traffic, it is the plea of this paper that the original construction be built sufficiently below the final grade as to permit using such construction as part of the foundation for a future strengthening or resurfacing.

**Classification of Highways.**—The building of highways has gathered great momentum in these days of rapid traffic service. Highways may be classed for convenience as:

1. The major system, comprising Federal and State Aid Roads.
2. The Minor System, comprising highways connecting the roads of the major system or important local roads.
3. The paved streets through or within towns and cities.

Major System: These highways are not only being extended, but the older highways are being strengthened and widened to meet the need of the extraordinary increase of motor vehicles, and traffic service. Generally no difficulty will be experienced in raising the grade above the surface of the existing pavement.

Minor System. By minor system is meant the connecting roads tributary to the major highway and important local systems or roads, laying, generally, wholly within the county unit. Attention is now being focused on the planning of these roads. Since all or a part of these roads may become major highways it is well to give heed in their planning to permit future utilization of their structures as a part of the ultimate road.

The final grade line should be established from 2 to 6 in. higher than the grade of the present planned road surface. The importance of length is paramount to width where funds are lacking or traffic is light. If only a single track road can be built, it is advisable so to do, as this road will afford all year round traffic for heavy loads and will crystallize sentiment for a wider road after use has demonstrated its great need. These roads may be built so as to permit progressive widening and strengthening. This is commonly known as stage construction, which has proved so successful in the economic development of our great railroad systems.

**Paved Highways and Streets in Cities and Towns.**—The establishment of a fixed grade in towns and cities is necessary and general. In planning new construction with the idea of using the new pavement in a future repaving or resurfacing project, it will be necessary to build the new pavement below the "fixed" or established grade. This can be done on all streets if adopted as a general policy.

The idea of utilizing a concrete pavement, which type of pavement by the way is peculiarly adapted to this procedure, first as a temporary wearing surface and structure combined, and later as a base for a future resurfacing, was first tried out by the writer in 1912 in the City of Chicago. Chicago at that time did not favor concrete as a suitable wearing surface, although it was used for base or foundation, along with macadam. The street, North Sawyer Ave., was therefore laid as an experiment under private contract. The roadway was 30 ft. wide, and the pavement 6 in. thick, using a 1:2:4 mix. Vertical concrete curbs were used. The surface was built 2/10 ft. below normal grade. Instead of expansion joints, contraction joints were built 12½ ft. apart across (transverse) the pavement. A recent inspection shows that the curb is in good condition, but the pavement at the joints has spalled badly but no appreciable settlement is apparent. Most of the 12½ ft. by 30 ft. slabs have two longitudinal cracks, a few slabs, but one crack, generally near the center line. Due to the poor finishing characteristic of the time when it was laid, the concrete was surfaced with a thin bitumen—sand surface known at that time as the "Dollarway" surface. Some of the bitumen is still visible. This pavement has given nearly 15 years service and is ready for resurfacing, after minor patching of the base at the worn joints. A 2 or 2½ in. asphaltic concrete surface would extend the life of the pavement, or rather the base, indefinitely.

**Pavements 2 in. Below Normal Grade.**—During the past year the writer has built all of the 6 in. concrete and a few of the 8 in. concrete pavements, laid under his direction, an average of 2 in. below normal grade. Using a flatter crown on concrete pavements, this will permit a resurfacing of 1½ to 2 in. thick along the gutter line and 2½ to 3 in. along the center or crown line. This will increase the crown about 1 in. which is desirable for an asphalt surface.

Fortunately, many of the older pavements we now seek to resurface, widen or strengthen consisted of a concrete foundation with a block wearing surface. Where the original crown was not too high, it is possible to utilize the old base in its entirety by removing the old wearing surface with its cushion and placing additional concrete or black base on the old base, where necessary.

Where a street is to be widened and the crown reduced, there is opportunity to utilize the old base to even greater advantage. Many of the older pavements in Chicago are being widened and the contour improved by flattening the crown, placing additional new concrete on the old concrete base, and using a thicker new concrete base on the widened, or previously unpaved portion. In some recent cases the old pavement is left untouched and the old gutter line left at the old grade, the widened portion sloping up towards the new curb. This is not a satisfactory method in my opinion. Economy is its main justification. Where a pavement is widened the choice of resurfacing materials are many. With a final grade 2½ to 3 in. above the surface of the initial concrete pavement, a 2½ in. brick; a 2 in. granite; reinforced concrete; asphalt, with binder or asphaltic concrete may be used.

It is probable the excessive thickness of the old Roman roads was due to the

building up of the old surface by many resurfacing thus improving as well as prolonging their use.

In closing, it is the writer's opinion that this idea of prolonging the use of a pavement, by planning for its future use as part of the foundation of the eventual pavement, is applicable to roads as well as streets where economy is important, or wise engineering approves of it.

# Cost of Constructing Concrete Pavement

## Data on 23 Miles of Work Given in Paper at 1926 Meeting Illinois Association of Highway and Municipal Contractors

By L. F. COLLIGNON
Of McCarthy Improvement Co., Davenport, Ia.

Quite a few years ago a Chicago contractor published his detailed cost data in an engineering journal and the observation was made by some contractors that it required a great deal of courage to broadcast such information to competitors. However, at most of the highway lettings in Illinois and Iowa, during the last year or two there were astonishingly low prices submitted and after each letting it was not unusual to have the low bid commented upon and analyzed by the other bidders. After hearing many of these it would appear to be the consensus of opinion of most contractors that what a competitor knows about the costs of others is not nearly so important as what he apparently (in the others' opinion) does not know about his own.

**The Cause of the Difference in Bids.**—It is safe to assume that all contractors who operate with ordinary efficiency have similar costs on such work as subgrading, material hauling, handling material, and mixing and laying paving, provided they meet with average conditions of soil and weather. The difference in bids arises not in the direct costs of labor, but in assumptions as to cost of owning and keeping up equipment and over-optimism in assuming that the most favorable conditions ever met with before can be expected on all future work.

Now while the direct labor cost of different contractors on subgrading, and mixing and laying concrete and various other operations will be very similar for all operating with ordinary efficiency where conditons are the same or where costs over a long period are compared, they will be far apart on most small jobs because conditions vary so much. A job of five or six miles might in some instances be completed in two or three months with not over three or four days rain each month. A contractor using his cost figures made up from such experience can perhaps easily land more work, but he will not be likely to meet those conditions twice in succession. Instead, he may have a month or two averaging four or five working days only. The only costs that are of any use and safe to base a bid on are average costs over a period of a year or more. The basis for cost data given here is work done in Iowa in 1924 and in Illinois in 1925, and covers about 23 miles of our work, on which the hauling equipment was trucks.

For the purpose of getting a definite figure on cost of depreciation and repairs of equipment, together with other expense incidental to owning equipment, I have used the data compiled by the Associated General Contractors' committee appointed for that purpose. They represent a fair average cost and are more familiar to contractors generally than any other cost figures.

**Cost of Subgrade Preparation.**—Average work per season, per mixer, based on thickness of Illinois standard paving, was 123,000 yd. Direct labor cost of subgrading and rolling was 9.4 ct. per square yard. Cost of depreciation, repair, taxes, storage of roller, tractor, subgrader, and scarifier, based on costs compiled by the A. G. C. was $2,850 per year, per outfit, which amounts to 2.3 ct. per square yard. Fuel and oil cost on the equipment was 0.4 ct. per square yard. Summarizing these we have for subgrade preparation:

| | Cts. Per Sq. Yd. |
|---|---|
| Direct labor subgrading and rolling | 9.4 |
| Cost of owning equipment and up-keep on same | 2.3 |
| Fuel and Oil | 0.4 |
| Total | 12.1 |

Now our direct labor is not at all times as high as 9.4 ct. There are many days that costs do not exceed 5 ct., and there will be miles of subgrading costing not over 7 ct., especially during summer, but costs mount when a stretch of rainy weather is encountered, or where soil conditions slow up operations on subgrader or mixer. A proportion of superintendent and field office expense is also included in the labor item.

**Working Days in Season.**—The season of 1924, according to our record, permitted work on 98 days only. The season of 1925, one of the most favorable we have had, gave us 110 working days. Many a day $50 or more is expended, draining subgrade or other similar work, with no progress in getting the paving laid. During a period of about ten years over which we kept a record, the average number of days for pouring concrete was less than 100 days. Straight time men draw pay for more than twice that number of days.

**Cost of Paving.**—Cost of setting forms, mixing, laying and hauling concrete, handling steel and center strip and curing with calcium chloride, averaged 15.2 ct. per square yard for direct labor. Cost of owning equipment, including depreciation, repairs, taxes, insurance, etc., according to report compiled by the A. G. C. is $10,950 per outfit per year. The equipment included is mixer, pump, forms, water pipe and form grader. Cost per square yard for equipment therefore is 8.9 ct. The fuel and oil cost 1.4 ct. per square yard.

Summarizing we have the following:

| | Cts. Per Sq. Yd. |
|---|---|
| Direct labor on forms, mixing, placing and finishing paving | 15.2 |
| Cost of equipment, including depreciation, repairs, taxes, etc. | 8.9 |
| Fuel and oil | 1.4 |
| Total | 25.5 |

What was stated regarding the subgrading applies also to the mixing and laying costs. They are not those experienced during favorable seasons or under ideal conditions, but they are average costs based on conditions that are met with in the long run.

**Equipment Costs.**—When the figures of the A. G. C. committee covering equipment costs are compared to costs of repairs and depreciation kept by contractors over a long period, they will be found to come surprisingly close. To the cost of equipment on subgrading and mixing and finishing paving as given above, totalling 11.2 ct. per square yard, add the equipment required for all other operations, excluding however, hauling equipment which should be figured separately. It is safe to say that no contractor averages less than 10 ct. to 12 ct. per square yard, as his cost on equipment, depreciation, repairs, taxes, insurance and incidental expense. And that expense is incurred and that much comes out of the contractor's pocket, for every yard of paving laid regardless of the fact that a contractor may shut his eyes to it for a year or a few years.

A few years ago I heard an Iowa contractor make the statement that he had paid for his equipment and that he didn't need to figure any equipment cost for the next few years. In other words, he believed that having been fortunate for a few years, he could afford to donate the use of his equipment for a similar period.

**Why Contractors Fail.**—Statistics gathered by insurance companies indicate that approximately 95 per cent of business ventures eventually end in failure. They do not show how many of these failures are contributed by the contracting business, but it is certain that of those who have fallen by the wayside, a great many have done so because of their failure to realize the importance of equipment cost.

In connection with this there is a paragraph of an address delivered recently by R. H. Towner before the Surety Underwriters Association, in which some of the more conspicuous failures are named. He states: "Every contract bond underwriter who remembers the names of the big contracting firms that he bonded 10, 15, 20 years

ago, can recall a long list of them that failed on some huge undertaking, causing surety companies a tremendous loss. Norcross Brothers; MacArthur Brothers; Larkin & Sangster; Fraser, Brace & Co.; John Pierce; George W. Jackson; Ellmore & Hamilton; Shanley-Morrison, Inc.; Wm. Bradley; Terry & Tench; Degnon, and a host of others. They failed and their places are being taken by new men." And every one can add a long list of his own of contractors who have come and gone during the last 10 or 15 years. The concerns named by Mr. Towner did not apparently suffer from lack of capital. Errors in estimating and judging costs must account for most of the failures.

Equipment constitutes by far the greatest part of a contractor's capital, therefore, it is one of the most important in figuring the cost of subgrading, mixing and laying concrete, as well as of any other operation in the course of laying paving, and one that may be most easily overlooked. But if the cost is consistently overlooked, like with those included in the list of failures cited above the consequences are certain failure.

## What Constitutes Substantial Performance?

A recent issue of the Bulletin of the Ohio Contractors' Association tells of a court decision that is of general interest. The case was that of Geo. W. Chambers, Claimant, v. The State of New York, Claim No. 18226, decided November 19, 1926, by the Court of Claims of the State of N. Y. The suit was brought by Chambers against the state for damages suffered by him when he was compelled to tear out part of a concrete highway and reconstruct same to meet the objections of the Highway Department. The contract of Chambers involved the reconstruction of an old macadam road by building two 9 ft. strips of 7 in. concrete separated by a 6 ft. strip of bituminous macadam.

In making core tests of the concrete, ten cores taken out of six contiguous slabs covering a distance of 320 ft. exhibited a thickness as follows:

Core No. 1—6.25 in. thick.
Core No. 2—6.50 in. thick.
Core No. 3—6.50 in. thick.
Core No. 4—6.25 in. thick.
Core No. 5—6.50 in. thick.
Core No. 6—6.53 in. thick.
Core No. 7—6.7 in. thick.
Core No. 8—6.25 in. thick.
Core No. 9—6.⅜ in. thick.
Core No. 10—6. in. thick.

Upon this showing, the highway commissioner compelled Chambers to take up these six slabs and relay them, upon the ground that they were not 7 in. thick, and therefore did not comply with the specifications. Chambers complied with the orders of the highway commissioner, and while the six slabs were being taken up, a state engineer on the job made measurements of their thickness. Sixty-six per cent of the measurements showed a thickness of from 7 in. to 8 in. From those measurements, taken when the concrete was being moved, it was found that the average thickness of the six slabs was as follows:

No. 1, average thickness 7.215 in.
No. 2, average thickness 6.812 in.
No. 3, average thickness 6.676 in.
No. 4, average thickness 6.844 in.
No. 5, average thickness 6.697 in.
No. 6, average thickness 7.1 in.

No question was raised as to the good faith of the contractor, and there was no charge that he had any intention of ignoring any of the provisions of the contract. It did not appear that anyone had any suspicion during the progress of the work that the contract was not being properly performed, and the original work proceeded to the satisfaction of the engineer in charge, and no question was raised until the cores were taken. Chambers claimed reimbursement from the state for the cost of relaying the concrete on the ground that the original work was a substantial performance of his contract. The court sustained this claim on authority of Jacob and Young v. Kent, 230 N. Y. 243; Woodward v. Fuller, 80 N. Y. 312; and Nolan v. Whitney, 88 N. Y. 648. The court observed that each case of this character has to be determined on its own particular facts, and expressly declined to lay down any general rule to govern in similar cases. The court said that all it desired to be understood in holding was that it was not satisfied from the evidence before it that a sufficient amount of concrete was laid thinner than 7 in. to enable it to properly find that the work done by the claimant was not a substantial performance of his contract.

## Traffic Survey at Boston, Mass.

The first scientific attempt to unscramble one of the most complicated and difficult traffic problems in the United States is now under way in Boston, where the city council has appropriated $25,000 for a comprehensive traffic survey of the metropolitan area under the direction of the Albert Russel Erskine Bureau for Street Traffic Research.

The congestion of street traffic has for the past several years been one of the most serious municipal problems in Boston, where solution of the traffic problem is considered to be particularly difficult because of the city's notoriously narrow and crooked streets.

The survey is expected to bring order out of the chaos of complex traffic regulations concerning parking, one way streets, right or left turns, and by its detailed study of traffic movement provide the necessary data for the installation of an efficient system of traffic control. At present Boston's entire signal system consists of one multiple light signal pole operated by an officer from the sidewalk, and two multiple light traffic towers operated by an officer from the inside of the towers.

A staff of forty counters and checkers started the work of securing detailed information on every phase of Boston's traffic movement. Scientific study will be made of such subjects as causes of congestion, causes of accidents, rules of the road, pedestrian traffic and its protection, organization and operation of traffic police, installation and operation of traffic signals, design and installation of traffic signs and markings, the handling of traffic law violations, and parking and garage problems.

The Boston survey is the fourth detailed metropolitan traffic study made by the Erskine Bureau under the direction of Dr. Miller McClintock. Dr. McClintock, director of the Bureau, which is endowed in Harvard University by a grant of the Studebaker Corporation of America, is the author of the Los Angeles model traffic code which has been adopted throughout Southern California, and of the report and recommenations of the Metropolitan Street Traffic Survey in Chicago, as well as director of a comprehensive traffic survey at present under way in San Francisco.

Both the Los Angeles code and the recommendations made for changes in Chicago's traffic system pointed the way to remarkable reductions in street congestion and accidents. In Los Angeles traffic movement was speeded up 50 per cent with a reduction of 30 per cent in the accident toll in face of a 35 per cent increase in vehicle registration. Among other things the Chicago survey showed that $27,000,000 a year could be saved by even a 10 per cent reduction in traffic delays.

The Boston survey is being conducted in cooperation with an advisory board on traffic, appointed by the mayor, and composed of representatives of city departments, members of the Chamber of Commerce, and representatives of all the leading bodies that may be affected by traffic changes to be proposed.

**Subgrade Preparation for Gravel Roads.**—In North Dakota the preparing of the subgrade is let by the mile under the surfacing contract and the contractor is required to bring enough dirt from the ditches to construct the shoulders to the height of the crown of the road on which the surfacing is to be placed. This leaves the compacted portion of the road intact, thereby eliminating the danger of wasting gravel by causing it to mix with a soft subgrade under heavy truck traffic. The contractor is also required to eliminate all wavy portions by hauling in extra material wherever necessary.

**Street Paving at Scranton, Pa.**—Scranton, Pa., will spend more than one million dollars on paving in 1927, divided among 34 projects.

# Chicago's Disposition of Street Traffic Violations

## As a Class, the Most Serious Cases Receive the Most Efficient Treatment. The Traffic Bureau with System of Automatic Fines Described in National Municipal Review

By GRANVYL G. HULSE
Albert Russel Erskine Fellow, Harvard University

The enforcement of street traffic law has been recognized as peculiarly different from other criminal law enforcement. In the violation of a large majority of street traffic regulations there is no moral turpitude involved and most authorities would take the violation of minor street traffic regulations out of the class of crimes. The Massachusetts Judicial Council suggests that these offenses shall no longer be crimes, but simply the subject of civil penalties, collectible by the clerk of the court. The Enforcement Committee of the National Conference on Street Traffic and Highway Safety, appointed by the secretary of commerce, said in its report of February 1, 1926, "While persistent and flagrant traffic violations should be vigorously punished, the ultimate objective should be elimination of violations. . . . Traffic violation bureaus, with a schedule of penalties, can quickly and effectively dispose of minor infractions, which constitute a large percentage of all violations, thus giving the courts more time to deal with the more serious cases." The Enforcement Committee also recommended special traffic courts for the largest cities. It said, "Uniformity will be promoted if the traffic cases are handled by the smallest number of judges able to handle them."

With the complete reports of the above bodies in mind the author has been conducting studies of the methods used in various cities for handling street traffic violations. These studies are being conducted under the supervision of Dr. Miller McClintock, director of the Albert Russel Erskine Bureau of Street Traffic Research, Harvard University. The following is a condensation of the study made in Chicago in the summer of 1926.

**Present Procedure.**—The traffic case begins with the arrest. The cases are of two kinds: those of a serious nature, such as driving while intoxicated, speeding or reckless driving; and minor violations, as listed on the back of the arrest ticket, including parking, lights, left turn, driving over curb, open muffler, and more than one hundred and fifty others of a similar nature.

In case of minor offenses the officer makes the arrest, serves a ticket known as the violation notification, and then releases the violator. The offender may then go to the traffic bureau and pay his fine as designated on the back of the ticket, or appear before the automobile court for trial. In minor infractions the officer does not make sure of the identification of the violator as carefully as he does in the serious cases. Consequently the violators often give fictitious names and addresses. This is discovered when the party fails to appear in court, and a warrant has been issued against them, but has not been served because of faulty identification.

The arrest for serious violations differs in that the offender must be able properly to identify himself, or go to the police station of the arresting officer and give bail. If the identification is satisfactory to the officer, the offender is given a summons which he must sign, agreeing to appear for trial upon a designated day in the district police court in the territory in which the offense was committed. Persons arrested by the West Chicago Park police are cited to appear at the weekly meeting of the West Chicago Park Safety Commission. Lincoln Park put into effect a system similar to that of the West Chicago Park late in the summer of 1926.

**The Automobile Court.**—The automobile court was organized in June, 1912. It was first known as the "speeder's branch," but a year later its jurisdiction was extended to include all street traffic violations. Even at that early date, the automobile problem was becoming a pressing one in the field of court activities. Persons arrested for traffic violations were required to come into court and wait for hours with all kinds of criminals until their cases were called. It was apparent that the street traffic violations were of a special character, and that some segregation should be made of these cases. Previous to the establishment of the "speeder's branch" "all violations of speed laws and other traffic laws were tried in the branch courts in the districts in which the offenses were severally committed. It was necessary to bring about a uniformity in fines and penalties in the several sections of the city. Further, by segregating these cases in one court it was possible to keep tab on the frequent and reckless offenders." Unfortunately the original segregation of speeding cases has been abolished, the speeders now being tried in the police district courts throughout the city. There is no attempt to keep a record of the repeaters, and no uniformity in sentence.

The automobile court, having been given jurisdiction over all traffic violations, continued to dispose of those cases until the docket became too large for one court to handle. When that came about the serious cases were again sent to the district police courts, the automobile court retaining only cases of a minor character. The automobile court continued to handle all the minor violations for the entire city until its docket became too crowded. The establishment of two and three automobile courts was tried, but the court considered it a waste of judicial time. The traffic bureau was then organized.

The automobile court has continued to the present day. However, the court today only handles the minor violations that refuse to pay at the traffic bureau, and the very few serious cases that arise in the central business district. It is deplorable that there is no attempt to handle the serious violations in any methodical manner, and that no record is kept of repeaters.

Having surveyed the class of cases the automobile court has handled, attention is called to the manner of their disposal, as shown by the following figures. During the period 1920 to 1926 the court disposed of 321,546 cases; of this number 117,052 were punished, leaving 204,494, or 64 per cent, who escaped punishment. The average fine given to the 36 per cent who were punished was $6.88. Looking further into the record of this period it is found that 74,889 cases were discharged for want of prosecution. The best year of the court as regards the proportion punished was in 1921, when 45 per cent were punished. The poorest year was 1925, when only 21 per cent of the total cases disposed of were punished.

The assignment to the automobile court does not seem to be a popular one. As many as twelve judges have presided over the court in one year, and in only one year has there been less than six. The constant change in the personnel of the court has discouraged any attempt to maintain a consistent policy of street traffic law enforcement.

**The Traffic Bureau.**—With the increase in the number of violations a more flexible court system became necessary and the model for such a reorganization was found in the traffic violations bureau of Detroit. The chief difference lies in the fact that in Detroit the bureau is operated as a branch of the police department, while in Chicago it is a branch of the municipal court. The Chicago traffic bureau established by the municipal court began operations on the 17th of March, 1926. For minor offenses within the jurisdiction of the bureau the court established

a list of set fines. The bureau has rendered a substantial service by relieving the congestion of the courts, and by saving the time both of violators and police officers.

When a violation occurs the police officer gives the violator a ticket which informs him of the law or ordinance violated, and directs him to report to the traffic bureau within thirty-six hours to answer to charge alleged. On the back of this ticket is printed a list of laws and ordinances pertaining to motor vehicle violations by reference, to which the violator may ascertain the penalty attached. If the violator prefers to settle at the clerk's counter instead of going to court, he signs his ticket, thereby waiving trial, and admitting the violation charged. He pays an amount according to a prescribed schedule of penalties classified according to the importance of the offense. A visible index enables the operator to ascertain within a few seconds whether it is the violator's first offense. Upon payment the offender is given a receipt, and his name, address, license number, and type of offense are immediately typed on an index card and placed in the visible index. The violator is not obliged to answer in person for his violation, he may sign his ticket and send the prescribed amount in currency to the traffic bureau by messenger.

The following data show the work of the bureau. The period taken is from March 17 to August 1, 1926. During that period 33,320 violators came before the bureau and voluntarily paid $69,353 in fines and admitted their guilt. Within the same period 4,736 cases were tried in the automobile court, and 1,056 were fined. This shows that of the cases going before the court 79 per cent were discharged. In the automobile court the average fine was $5.36, in the bureau $2.08.

The record of the traffic bureau indicates a willingness on the part of the violator to come in and pay his fine. To insure the continued success of the bureau there must be full co-operation on the part of the judge in the automobile court. Laxity on the part of the court will encourage violators to demand a trial, hoping they may talk the judge out of the fine. With 79 per cent of the cases now being discharged (during period in preceding paragraph), and only a fine of $5.36 being given, there is ground for this hope.

The following table indicates the comparative effectiveness of the bureau in measuring discipline to a large number of offenders:

**Number Fined in Traffic Bureau and Automobile Court**

| Four months under new system. Voluntarily paying fine and admitting guilt | Number punished in other years, after trial | | | | | |
|---|---|---|---|---|---|---|
| | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 |
| 33,320 | 10,694 | 25,108 | 20,156 | 34,381 | 13,381 | 12,983 |

**The District Police Courts.**—The district police courts handle the serious traffic violations. These are disposed of with the other criminal cases, although certain days of the week are set aside more particularly for street traffic violations. There is no attempt at uniform policy, or the maintenance of violators' records. There is an excellent chance for politics to enter and attempt to influence the disposal of cases. The most serious cases in the city are dealt with in the least organized manner.

The district police courts handle a little over 30 per cent of the street traffic violations, and all these violations are classified as being of a serious nature. At the same time their convictions only total about 13 per cent of the total number of convictions. The next tabulation indicates the nature of the disposal of these serious violations.

The following table shows that 75 per cent of the cases coming before the district police courts were discharged in one way or another, that is, escaped punishment. The table would further indicate that the cases were not adequately prosecuted. The small percentage of punishment may be laid to the leniency of the courts, failure of police officers to produce the evidence necessary to convict, or refusal by one prosecution to follow up the cases.

**Disposition of Cases in District Police Courts, January to June, Inclusive, 1926**

| | Cases disposed of | Discharged | Fined | Jailed | Probation | Non-suit or nolled | Discharged, want of prosecution |
|---|---|---|---|---|---|---|---|
| Ordinance | 15,396 | 9,973 | 3,328 | 136 | 14 | 319 | 1,626 |
| Statutory | 17,492 | 11,212 | 4,417 | 157 | 119 | 90 | 1,497 |
| Total | 32,888 | 21,185 | 7,745 | 293 | 133 | 409 | 3,123 |
| Per cent of total cases disposed of | 100% | 65% | 24% | .7% | .3% | 1.2% | 8.8% |

**The Park Commission.**—We find still another agency handling street traffic violations, that is, the safety commission of the West Chicago Park. (The Lincoln Park Board has recently adopted a similar plan.) The West Chicago Park Safety Commission was adopted in July, 1924, because it was felt that the city of Chicago was doing little to educate the violators. The West Chicago park commissioners having the power to deal with these violations set up this safety commission composed of citizens of the park district to seek the co-operation of the motor vehicle drivers in making the streets of that district safer for all persons.

The safety commission is not a court and no punishment is given. If a violator fails to answer the citation to appear before the commission, he is arrested and sent to one of the city district police courts for trial. The members of the safety commission explain to the offenders the character of the ordinances and seek their assistance in making the streets safer. The keynote of its work is education and co-operation.

Examination of the accident and death records on the streets of Chicago show a decided decrease in the West Chicago Park District. The commission feels that its work is to a great extent responsible for this condition. They do obtain a great deal of co-operation from the police of their district, which undoubtedly aids in building their fine record.

**New York City Has Spent $463,000,000 for Subways.**—New York City's investment in subway construction to date is fairly close to half a billion dollars, it was disclosed in figures made public by the Board of Transportation in a statement outlining the work of that board in its three years of existence. "The total disbursement on behalf of the city for all rapid transit construction purposes," says the statement, "beginning with the first rapid transit construction expense in 1900, to the end of June, 1927, amounted to $463,172,774.60. The Board of Transportation, in three years, authorized the payment of $110.452.954, or 24 per cent of Father Knickerbocker's entire rapid transit construction cost over a period of 27 yeas." The total of contracts awarded by the board, however, has been greater than the amount of expenditures—actually $189.632,580, of which $163,861,050 was for the city's new independent subway. It has now before it ten bids for the construction of the Nassau-Broad Street subway, one of the most difficult and costly of subway construction undertakings. The lowest bid is $10,300,000 and the highest $13,800,000. When the contract is awarded for this work the board will have actually awarded more than $200,000,000 of contracts.

The contracts the board has awarded in its three years of work since July 1, 1924, are divided as follows:

| | |
|---|---|
| City's new subway system | $163.861,060.30 |
| Interborough system | 4.601,479.77 |
| B. M. T. system | 20,292,459.44 |
| Track materials | 783 573.70 |
| Miscellaneous | 94,007.60 |
| | $189,632,580.21 |

# The New Well System of Amarillo, Texas

## How Compressed Air Was Used in Developing Wells Described in Paper Presented June 7 at 47th Annual Convention of American Water Works Association

By WYNKOOP KIERSTED
Consulting Engineer, Kansas City, Mo.

Amarillo, Tex., is a city of about 50,000 population. The 1920 census credits Amarillo with a population of 15,494 and it was not until about 1925 that the inhabitants greatly exceeded this number. About that time the production of oil and gas in the Borger field, 60 miles northeast of Amarillo, increased with great rapidity over an extended area. Amarillo, located as it is at the intersection of three railroads and already the important distributing point in the Texas Panhandle, grew rapidly. Fortunately for Amarillo the oil field is far enough from the city to remove the inconveniences of oil boom operations but close enough for advantageous business transactions.

The present water supply for Amarillo is taken from thirty-seven wells scattered throughout the city. The water of some of the wells is piped to a storage reservoir at the distributing pumping station, whence it is repumped into the distributing pipe system against a service pressure of about 45 lb. The water from the other wells is pumped directly into the distributing system.

These wells, 300 ft. or more in depth, require a lift of at least 270 ft. to deliver water at the surface of the ground. The total lift, including service pressure in the distributing system is 375 to 400 ft. The cost of operating the plant has been unusually high because of the wide distribution of the wells, the high lift and the relatively small yield of water from an individual well of 50 to 75 gpm. Fire service has been supplied by pumps in the main pumping station from a fire service storage reservoir.

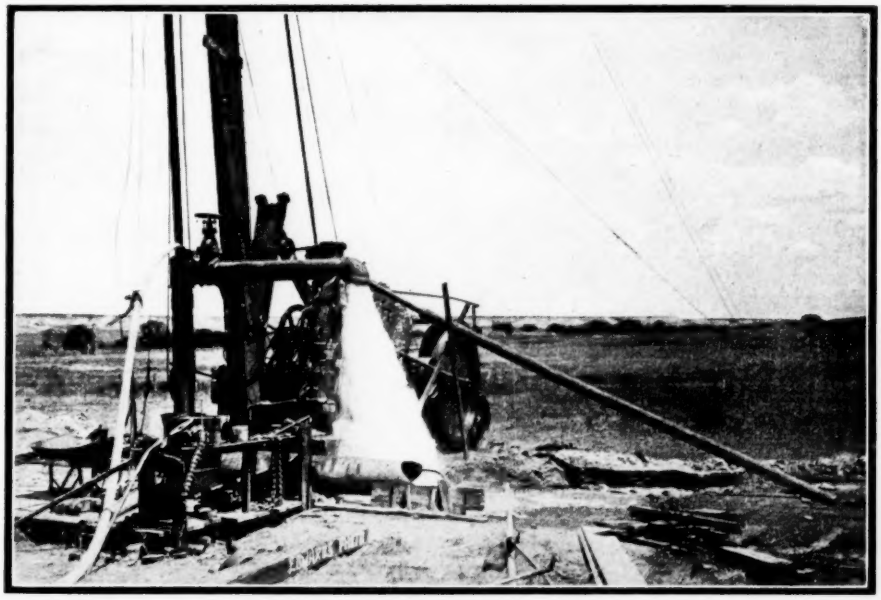
The original plant was built in 1901 by H. B. Jones, the present city engineer. It has since passed through several private ownerships and was acquired recently by the city. The city is now reinforcing the distribution system and constructing a new water supply works. The studies for a new water supply were commenced in 1922 by H. B. Jones, city engineer, and Wynkoop Kiersted, consulting engineer. They took into consideration both the impounding of surface water and the development of well water along a stretch of nearly 20 miles in the Palo Duro Canyon both southeast and southwest of Amarillo. The several sites southeast of the city were rejected because erosion had drained the quaternary sand deposits of water and because of the porous nature of the side slopes and floor of the canyon. Although the final report recommending the development of both well and surface water supplies about 16 miles southwest of Amarillo was made in May, 1923, no start was made on the final plans until 1926.

The development recommended by the engineers and accepted by the city comprises the drilling of 7 wells of at least 500 gpm. each, the construction of an earth dam impounding over 1600 million gallons in the Palo Duro Canyon, a well water reservoir and pumping station at the dam, a pipe line 83,000 ft. long connecting the water supply works with a storage reservoir and a distributing pumping station with elevated tower and tank in Amarillo. The cost of the complete development in round numbers will be $2,100,000.

The total ground water supply available at the site was estimated at 7,000,000 gpd. and the impounded supply from a catchment area of about 400 square miles at 3,000,000 gpd. It is thought that seepage from the impounding reservoir will be high at first but that the loss of water will diminish over a 3-yr. period as the general water table is raised in the locality and as the porous ground near the dam becomes sealed with sediment.

The wells are located from 1,000 to 1,500 ft. apart. Two of the wells are below the dam and the others are located near the high water line and upon the north and south banks of the impounding reservoir. The present upward slope of the water tables on both sides of the Palo Duro Creek will be reversed under the influence of reservoir storage and doubtless will raise the standing level of the water in all the adjoining wells and increase their yield. At present the standing water level is 20 to 40 ft. below ground surface.

**Drilling the Wells.**—The wells were drilled into the fine sand to an average depth of about 200 ft. using a 30-star drilling machine weighing 52,000 lb. The use of this heavy machine was necessary in handling the heavy casing used in the well. A 6 in. pilot hole was first put down to the clay stratum to develop the geological and water-bearing structures as a guide to the major operations. A 30-in. hole was then sunk about 80 ft. to the water-bearing sand. Inside of and concentric with the 30-in. casing was set a line of 20-in. oil well casing weighing 95 lb. per foot. The 20-in. casing was bailed down to the clay substratum at a depth of 150 to 180 ft. below the ground surface. A 15½-in. hole was next drilled into the clay of sufficient depth for submergence of air lift pumps. The permanent well casing is 12½ in. in diameter and weighs 50 lb. per foot. In this line of permanent casing was inserted the strainer section so located as to reach to the bottom of the water-bearing sand. The perforations in the pipe are slots ⅝ in. wide by 4 in. long. About 500 such slots were burned in the 20-ft. section of casing forming the strainer.



Pumping Out Sand Laden Water During Well Development

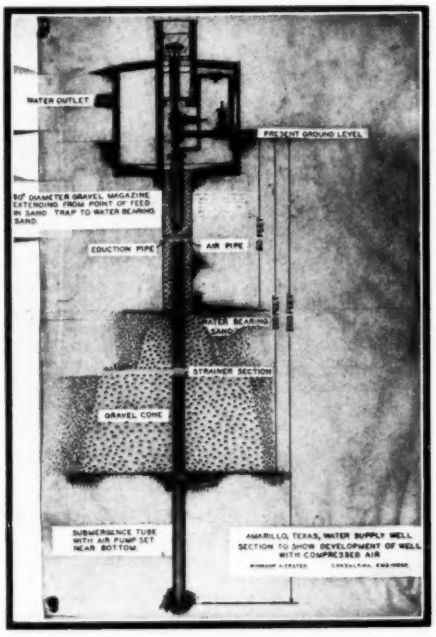
An air pump was next inserted in the 12½-in. casing having an 8-in. eduction pipe extending 196 ft. below the ground surface. The next step in the development of the well was to drop a few cubic feet of gravel into the space between the 12½-in. and the 20-in. casing and to connect the air pump with two of three compressors actuated by gas and steam power.

**Development of the Wells.**—The setting now being complete for the development of the well, the 20-in. casing was pulled slowly, a few inches at a time, and water pumped by air lift from the well. As water was pumped sand flowed freely under the 20-in. casing and thence out of the well and the gravel between the outer and inner casing settled. Pumping continued moderately until the water cleared. The clearing of the water indicated that the cavity formed by the removal of sand had filled with gravel and that the velocity of water at the surface bounding the deposited gravel was so low that the sand would not carry through the voids. With clear water flowing the 20-in. casing was raised a few more inches, thus increasing the velocity of water and again a heavy flow of sand occurred. In order to keep the sand and gravel thoroughly agitated and the gravel forced back into the cavity made by the developing process the well was alternately pumped and "back blown." To back blow the well the discharge valve was closed. The escape for air through the eduction pipe being thus shut off the air after forcing water out of the eduction pipe into the ground, passed through the strainer opening and bubbled up through the gravel causing it to "boil." The back blowing action also kept the gravel from arching in the casing and the "boiling" or rising and falling of the gravel had the effect of forcing the gravel away from the well strainer. The valve upon the discharge pipe was opened after each 2 to 15-minute period of back blowing. The pressure in the well, thus suddenly reduced to nearly zero from a pressure equal to the full head of water in the ground, caused an inrush of water at high velocity and a heavy flow of sand with it. The well was again pumped after back blowing until the water cleared.

The process of pumping, "back blowing," raising the 20-in. casing and feeding gravel enough to keep the upper gravel surface a few feet above the end of the 20-in. casing was continued intermittently until this casing had been entirely withdrawn. The space between the 12½-in. casing and the wall of the 30-in. hole was then filled with gravel to the ground surface. Alternate pumping and back blowing was continued until the inflow of sand became small.

At least 100 cu. yd. of gravel was used around the strainer pipe of each well, more gravel being deposited at the bottom of the wells and around the strainers than at the top of the sand strata. A test hole put down 6 ft. from the center of several wells encountered the deposited gravel in each case but additional test holes were not drilled to define the shape of the green cone. From the uniform texture and size of the sand it is believed that the distribution of gravel around the strainer is uniform and somewhat conical in shape. About 35 working days are required to make a well by the above described process at a cost of $14,400 each.

The unusual feature about this work is that from 500 to 800 gal. of water per minute is developed from a single well sunk in sand too fine to furnish such a flow of water from wells constructed by the usual methods. Many mechanical analyses of the sands from these wells were made, which for several of the wells, but typical of all, average 40 to 52 per cent retained on a No. 60 sieve and from 60 to 68 per cent retained on a No. 8 sieve. The large yield of water from this grade of sand is due to the extended distribution of graded gravel through the use of compressed air.


WATER OUTLET
PRESENT GROUND LEVEL
EDUCTION PIPE
AIR PIPE
WATER BEARING SAND
STRAINER SECTION
GRAVEL CONE
SUBMERGENCE TUBE WITH AIR PUMP SET NEAR BOTTOM
AMARILLO, TEXAS, WATER SUPPLY WELL SECTION TO SHOW DEVELOPMENT OF WELL WITH COMPRESSED AIR

**Section Showing Development of Well With Compressed Air**

**How the Run of Sand Is Handled.**—A continual run of sand in small amounts is expected of the wells in operation. In order to meet this situation each well head consists of a reservoir forming a sand trap. These well heads are designed of reinforced concrete of sufficient capacity to allow the send to settle out as water is being pumped. Provision is made for the removal of sand from the traps by flushing. In order to prevent the graveled well strainers from becoming sealed with the fine sand, provision is made for back blowing the wells through properly valved connections, disposing of the sand ladened water after back blowing through a waste pipe which by-passes the sand trap; also provision is made for feeding gravel simultaneously with the back blowing and thus to avoid the danger of the well eventually caving. It is thought that the periodical back blowing and graveling of the wells will progressively improve the conditions for an increasing yield of water which is an expectation quite the reverse of that for the ordinary fine strainer well in fine sand strata.

Besides the sand traps at the respective well heads there is an additional sand trap at the 500,000-gal. covered reservoir receiving the water from all the wells. This receiving reservoir has a weir chamber for measuring the water delivered from the wells.

The air lift method was selected for pumping the wells because of the provision thus afforded for back-blowing combined with the advantage of the absence of moving parts to be cut with sand.

## Sterilization of New Mains with Chlorine

In his paper presented at the recent convention of the American Water Works Association, Arthur E. Gorman, Chief Sanitary Engineer of the Division of Water Safety Control of Chicago, has the following to say regarding the sterilization of new water mains in that city:

The chlorination of new mains is considered an important public health measure. It is carried out by the Division of Water Pipe Extension in cooperation with the Division of Water Safety Control. In spite of precautions, pollution of mains in laying result. This is especially true if the mains happen to be near "live" sewer or if working conditions are difficult. The procedure is to apply chlorine gas from tanks through a flexible lead line and a corporation cork fitting at a point below the new section, having shut off this main from the rest of the distribution system. While the chlorine is being applied one or more hydrants are opened up-stream in the vicinity of the shut-off valve until very heavily chlorinated water, as evidenced by the odor, has flowed freely from the hydrant for about an hour. After this the chlorine supply is shut off and the main flushed until water at the hydrant is free from residual chlorine. Two bacteriological samples are then collected of the flowing water from the hydrant and in addition from a tap in a home or at a hydrant supplied from the main below the point of sterilization. If at the end of 24 hours fermentation tests for B. coli are negative the main is approved for use; if not it is kept out of service until the bacteriological findings are negative. Occasionally sterilization of the main must be repeated, but if the procedure is carried out carefully and the new main properly flushed this is usually unnecessary.

# Sewage Disposal in Great Britain

## Notes on 1927 Practice Given in Paper Presented at Recent Annual Meeting of Institution of Municipal and County Engineers

By J. D. WATSON

Late Chief Engineer of the Birmingham, Tame and Rea District Drainage Board

For some years past the best known purification processes have moved forward somewhat slowly. Bio-aeration, the newest and least understood process, has been kept well to the front by the biologist, the chemist, and patentees whose enthusiasm for it has kept both consulting and executive engineers in England from being unduly conservative. In America the engineer seems to have been more sanguine than he has been in this country, but there conditions are more favorable to this process, inasmuch as sewage is invariably weaker in composition and electric power cheaper. For instance, at Chicago power for bio-aeration plant will cost about 2-3 ct. per unit.

Some local authorities, who have realized the need for improving and extending their purification works, have purposely held back to see whether the bio-aeration or activated sludge process would supersede land treatment and bacteria beds. Others, with the object of inducing rivers authorities to go slowly, have taken advantage of authentic reports of difficulties and troubles; while others have demonstrated the practicability of the new process, thus adding to that knowledge and experience which is essential to steady progress.

That bio-aeration is not suitable for the treatment of all sewage was evident from the beginning, and if partial failures were assessed at their true value it would probably be found that some miscalculation or wrong application of a sound principle had led to the failure. Activated sludge, bio-aeration, bio-flocculation, or some other more appropriate name by which this process may yet be called, has established its position, even although we have not seen the last mistake which its over-zealous and inexperienced advocates are likely to make.

There is no truer saying than this, that the man who never made a mistake never made anything, but members of this institution, conscious of their responsibilities as the professional advisers of local authorities, are desirous of appraising old and new methods at their real value and adopting the best.

There is no statement in existence to show the methods of purification obtaining at all the sewage works in this country, but it is of material value to be able to refer to the questionnaire which was issued five years ago by the Association of Managers of Sewage Disposal Works. Of the 99 returns which were received:

Land is shown to be in use at 14 works.

Contact beds are shown to be in use at 23 works.

Percolation beds are shown to be in use at 72 works.

Purification by dilution or by activated sludge is not referred to in the questionnaire.

**Purification by Dilution.**—Speaking broadly, it is correct to say that all sewage is finally disposed of by dilution, and it is equally true to say that, where the laws of nature are allowed to assert themselves, dilution may be, and frequently is, a purification process in itself. Organic impurities are rendered innocuous or are dissipated by bacteria and protozoa, which form the plankton of the waters.

As with all methods of purification effected by the forces of nature, anyone guilty of over-taxing the purifying power available courts disaster (as instanced in the well known cases of the Thames, the Clyde, the Chicago Canal and many others); but when the volume of sewage is reasonably apportioned to the volume of diluent, salt or fresh, dilution is an authenticated method of purification which never fails.

There are many English instances of sewage being discharged into tidal waters and into the sea direct (with and without preliminary treatment), and no one who is unfamiliar with all the circumstances can possibly say whether the best course has been adopted in each specific case or not, but in view of the opinion expressed by the Royal Commission on Sewage Disposal regarding the efficiency of this method, it is clearly the duty of every local authority which has large volumes of river or sea water close at hand to take advantage of such for purification by dilution before they decide to construct expensive plant to do the same work artificially.

There are, of course, good ways and bad ways of giving effect to a sound proposition, and there has been an inclination sometimes to forget that if nature does not provide an efficient method of dispersing the sewage when it enters tidal water it may be possible for the engineer to provide a remedy artificially. In other words, it is unwise to discharge a great volume of sewage into comparatively still water without making provision for the most complete mixing process available, when one knows that oxidation of impure liquid depends upon the dissolved oxygen present in the diluent into which it is discharged.

The American engineer has had of necessity to consider this aspect of the question more than we have in this country, because he is so frequently obliged to discharge sewage effluents into comparatively pure water. It is no uncommon thing to draw potable water from an American lake into which a sewage effluent is being discharged at some point or other. In such a case quick and effective dispersion becomes essential, and it was to overcome one of the difficulties of such a case that the multiple outlet was designed.

One of the first, if not actually the first, of these multiple outlets was advocated in a joint report to the city of Toronto in 1909 by the late Dr. Hering and the author, when they recommended the local authority to carry the outfall into 30 ft. of water by means of a pipe extending for a distance of 3,500 ft. from the shore, this pipe to be provided with small openings or branch pipes to facilitate oxidation by effecting equal and speedy disposal of the sewage effluent. The Boston and Passaic Valley outfalls are very successful examples of this multiple outfall method, the latter having no fewer than 150 nozzles acting as diffusers. Where tides and currents exist near the outfall, this quick mixing by multiple outlets may not be needed, but they certainly contribute under all circumstances to the fulfilment of a sound principle.

**Purification by Land Irrigation.**—Where soil and sub-soil are suitable and the volume of sewage to be treated is well within the purifying capacity of the area available, land irrigation is probably the soundest method of purification. Different opinions may be held regarding what are favorable conditions, but it may be assumed that, where there is one acre of suitable land per 100 persons, an efficiently worked sewage farm, when judged by the standard of effluent produced, is still in the front rank.

Berlin, Paris, Nottingham, etc., still follow this method of treatment, but before war broke out in 1914 the Paris authorities had decided to put down an installation of percolating filters to relieve the pressure imposed upon their sewage farm. The effluents from such a farm have less variation in character than effluents from other kinds of sewage purification plants. They are noted for their freedom from micro-organ-

isms, and their almost uniformly good and clear effluent. Moreover, the effluent on analysis almost invariably gives a low figure on the dissolved oxygen absorption test.

At first sight it may not appear to be an advantage when land effluent is spoken of as having a very low nitrate figure, but on reflection it is realized that where a small and comparatively pure stream receives an effluent containing reserve oxygen in the shape of nitrites or nitrates, there is great danger of encouraging growths which decay later and add to the organic matter which settles in depressions of the stream bed.

**Purification by Contact Beds.**—In the order of sewage purification development the contact bed comes next to land irrigation, but one cannot say for it what has been said for land irrigation, that it stands where it did. It is not, in the opinion of experts, either a sound or an economical way to oxidise and free sewage from its tendency to putrefy.

A bacteria bed depends mainly upon the free admission of air into the heart of a carefully prepared structure of uniform medium, and one of the governing factors in gauging the worth of a contact bed is that the volume of air supplied to this form of bacteria bed shall be equal to no more than the volume of sewage treated, whereas it may be equal to many times that volume when the sewage is sprayed over the surface of a percolation filter.

That the contact bed is capable of oxidising sewage efficiently there is no doubt, but compared with other biological methods of treatment it is less reliable. The beds readily become clogged with suspended matter; they consequently lose capacity, and the medium has to be taken out, cleaned and replaced too frequently. If much suspended matter is put on fine filters, they are likely to choke unless the time of aeration is increased abnormally. The Royal Commission stated that 1 cu. yd. of medium used in the form of percolating filters is capable of performing the same duty as 2 cu. yd. of medium used in the form of contact beds.

This economical fact is a prominent factor in the diminished popularity of the contact bed. There are good beds in the country which render capable and efficient service, but the author has not heard for some years of a new bed of this type being built, and it is a matter of common knowledge that the contact beds which were constructed at Manchester 25 years ago, and others much more recently at Sheffield, are now being replaced by installations of activated sludge and bio-aeration.

**Purification by Percolating Filters.**—The percolating filter is popular, and deservedly so. It is comparatively cheap to construct where good medium is obtainable in the locality; the operating cost is low, and the effluent when passed through a well designed humus tank is clear and non-putrescible. For 20 years or more this form of oxidising filter has been almost without rival.

Compared with an activated sludge plant it may be called "fool-proof," and its bacterial population is wonderfully adaptable to varying conditions, including change of temperature and character of the sewage to be treated. These good attributes often tempt an untrained manager to leave the filter so long without attention that it is made to appear as if it were constitutionally weak, whereas it has been badly damaged by neglect.

In first cost a percolating filter is more expensive than an activated sludge plant, but it is cheaper from the ratepayers' point of view, because the assessment required to meet principal, interest and maintenance is less, and this, after all, is the real test. The process in view of its reliability to produce good effluents at a low maintenance cost is not behind in the race for economy. It is not, however, free from potential nuisance. Where it occupies a large area it is advisable to locate it as far from dwelling houses as possible (of course, within reasonable limits of cost), for one cannot forget that even in this country there are recurring periods of close, warm weather when fly nuisance and nauseating odors become so oppressive that residents in the locality complain of the proximity of the filters.

In spite of this there is no gainsaying the fact that the percolating filter is popular with the engineer, the local authority, the manager of the works, and last but not least, the rivers authority. This very popularity may be unduly stressed, and sometimes it may lead to neglect of the bed and to its being deprived at the right moment of that skilled attention so necessary to avert falling away from normal high-class work.

Too little attention is paid to changes which invariably and inevitably take place in the character of sewage arriving at the works. These may be due to the emission of trade wastes from new factories, or to the development of new branches of industry within existing factories, but, whatever the cause, sudden changes in the composition of the sewage or the relative proportions of trade waste to domestic sewage places a burden upon a purification plant which even a percolation filter may be unable to bear. These features are more pronounced when the plant is small than they are in a great town with corresponding large purification works. Gas-works, dairy factories, sugar-beet factories and others set up in small towns and country districts emit waste products which produce inhibitory effects upon sensitive purification plants; but whether the falling away of the percolation filter effluent is due to factory waste or not, an effort should be made by the local authority or their engineer to ascertain the cause as soon as possible before irreparable injury is done, even if it is found necessary to call for an independent report.

In this respect local authorities are much more understanding and more sympathetic than they were a quarter of a century ago. They realize that however good new works may have been when they were constructed originally, they are not maintained without foresight, sound judgment and hard work on the part of their officers, who in turn should keep them duly acquainted with changes which deteriorate the quality of the effluent and lead to complaints from the rivers boards.

**Purification by Activated Sludge.**—The activated sludge or bio-aeration process is not so popular as it was a few years ago—not that it has gone back in the estimation of the experts, but it has failed to maintain its popularity in the estimation of local authorities. It is probably suffering from the untoward zeal of some of its advocates and their belated consciousness of its limitations.

Nothing has happened in the past few years to shake one's faith in the value of this process per se. Its suitability for certain kinds of work is unchallenged. It has proved itself to be scientifically sound. It concentrates the purification process by confining the whole operation to one or more tanks, but it is not suitable for the treatment of all kinds of sewage, nor is it economically adaptable to all situations. It is sensitive to quick change in the character of the incoming sewage. The maintenance of a fixed volume of given trade waste to a given volume of domestic sewage is of greater consequence than it would be in a less sensitive plant, and its success as a reliable method of purification requires more knowledge and skilful management on the part of the local authority than the older and better understood methods of treatment.

The names activated sludge and bio-aeration have been directly associated with the Manchester and Sheffield plants, but other mechanical contrivances working at Bury and Birmingham include what have been called the Simplex surface aeration and the Spiro-Flow processes.

It is all to the good that there are different ways of applying the principles involved in this process of sewage purification. They are all trying to reach the same goal by different, but more or less direct, routes.

By the first and best known method air is forced through porous tiles placed in the bottom of great channels or elongated tanks, through which sewage is made to flow, and is kept in constant contact with dissolved oxygen and minute particles of sludge, each particle acting as a nidus for innumerable particles or aerobic bacteria.

Mechanical agitation has proved itself to be sound in its conception, and may in some instances be cheaper in its operation. It may be quite as re-

liable in the production of a good effluent; it may be a simpler mechanical plant unencumbered by patent rights to control the process, and yet it cannot be said that the Sheffield method has taken a greater hold of the consulting engineer than the Manchester method.

It should not for a moment be assumed that an ideal method of utilizing the principles of the process has yet been discovered. The plant inaugurated at Essen-Recklinghausen, which combines both air-blowing and mechanical agitation, may yet be a keen competitor, if it proves to be as economical as it is reputed to be efficient. It will provide a stimulus to our mechanical engineers to emulate and excel what has been done in Germany.

The principal object to be gained by adopting activated sludge or bio-aeration should be clearly kept in mind. The public have been led to believe that this new discovery will result in the supersession of land irrigation and bacteria beds. This is not the case. The discovery has added another excellent method of purifying sewage to those already available, but it is not necessarily the best method. It is not suitable for the treatment of every sewage, nor is it, generally speaking, so reliable under all circumstances as the older and better-tried methods. Indeed, the very fact that it required so much more skilled attention than either land irrigation or bacteria beds, renders it unsuitable where the works are isolated and small. It has, however, opened up paths by which existing biological plants like contact beds and percolation filters may be rejuvenated and made more capable of treating the volume of sewage for which they were originally designed, by relieving them of work for which they are not suited.

All who have had experience of the management of bacteria beds are conscious of the handicap created by spraying tank effluent of a highly colloidal character over the surface of a bacteria bed. Given sufficient time, aerobic bacteria and higher organisms, like Achorutes, will free a bacteria bed from viscous matter which sometimes spreads itself over the surface like a sheet of soft indiarubber; but if the activated sludge process is adopted as an auxiliary to bacteria beds the sewage liquor, after it has been subjected to air blowing or surface agitation for even one hour, is free from colloids and other viscous matter in a marvellous way. As a result a bacteria bed will be able to oxidise at least double the quantity of liquor which it could oxidise if that liquor still held colloidal matter.

At Birmingham, as the result of experiments extending over some years, the author recommended the joint drainage board in the spring of 1922 to put down an auxiliary plant of this kind, and the grounds emphasized in making the recommendations were as follows:

(1) That the Birmingham sewage is amenable to treatment on this principle—bio-aeration.

(2) That a tank liquor forms a better subject for purification than crude sewage.

(3) That agitation of tank liquor for one hour removes 60 per cent of its impurity.

(4) That agitation of tank liquor for one hour removes all objectionable smell.

(5) That agitation of tank liquor for one hour produces a liquor which may be oxidized at double the present rate on a percolating filter.

This recommendation was adopted, and Mr. Whitehead, the engineer to the board, is now building a plant.

The Birmingham experience envisages a much wider application of the activated sludge process than has been contemplated hitherto. It deals with a tank effluent from which sludge has been partially eliminated and reduced in volume to about 10 parts per 100,000 by passing crude sewage through ordinary sedimentation tanks, thus minimizing to the fullest extent one of the greatest drawbacks to the bio-aeration process as it was originally put forward—viz., de-watering and disposing of great volumes of spent or exhausted activated sludge. It gets rid of foul odors and enables a bacteria bed to oxidise twice as much sewage.

**Standards of Purity.**—A reasonable comment on the five leading methods of purification referred to is that they are all feasible, and that the responsibility for adopting the best in any given circumstances must rest upon the local authority, who presumably act upon the advice of their own engineer, with or without the help of a specialist. There is no one-way road in this matter. There can be no stereotyped method of dealing with an ever-changing liquid like sewage, nor can there be any fixed standard by which all effluents are tested for purity.

The seventeenth section of the Public Health Act, which we dislike, is not without its merits, for it does recognize that there should be a definite relation between an effluent discharged into a fishing stream and one which flows into a tidal estuary.

The Royal Commission realized that the seventeenth section could not be complied with where a sewage effluent had to be discharged into a pure stream, and they put forward the dissolved oxygen test as being more equitable, but it has not met with general approval, and the recent dispute at Worcester about the significance of the test as a reliable evidence of the purity of the water tested is not likely to make it more acceptable to local authorities responsible for the purification of sewage.

As regards the popularity of various other methods of sludge disposal, reference may be made to the result of the questionnaire already referred to. Returns were received from 99 sewage works, and although they did not all confine themselves to a single method, the following statement is helpful:

| | | | |
|---|---|---|---|
| Lagooning | was employed at | 57 | places |
| Land | " | 15 | " |
| Lagoons and land | " | 5 | " |
| Pressing | " | 12 | " |
| Pressing and lagoons | " | 6 | " |
| Digestion and air drying | " | 1 | " |

The expression lagooning is not very definite, and it probably includes trenching into land in some instances; but, whatever it includes, it has taken the place of pressing so common some years ago, and although it is more representative of English practice today than any other single method of treatment, it is far from ideal, especially as regards the smell nuisance.

In this respect digestion and subsequent air drying possess merits which have not been sufficiently recognized. The well known Imhoff or 2-story tank ensures digestion in proportion to its efficiency, but it has not found favor here, although its prototype, Dr. Travis' hydrolitic tank, originated in England. Nevertheless, the Imhoff tank produces a non-smelling sludge, and is worthy of more notice than it has received. The principle involved is followed by three local authorities in England—Birmingham, Bath and Chorley—where complete digestion in "single-story" tanks secures a reduction of one-third of the volume of sludge, elimination of fat, conservation of nitrogen and the all but entire removal of foetid odor.

Activated sludge in its fresh state contains about 5 per cent of nitrogen, but unlike digested sludge, it does not part at all readily with its moisture, which is 99 per cent of its volume. Many unsuccessful attempts have been made to separate solid from liquid. In a tropical climate the combination may be no disadvantage, but in a climate like ours it is, and it points to the desirability of activating only that volume of sludge that is absolutely required to effect efficient flocculation instead of burdening the plant, and subsequently the drying process, with more solid matter than is absolutely necessary.

**Treatment of Storm Water.**—As time advances and conditions change there is an inclination to minimize the value of some of the recommendations of the Royal Commission; for instance, the proposal to set up a central authority to deal with the many anomalies surrounding this complicated subject, and with some questions of detail. It should be borne in mind that their conclusions related to conditions obtaining 20 years ago, and although 95 per cent of them may be applicable to present day conditions they cannot be expected to apply when conditions change.

The Royal Commission could not foresee in 1908 the impervious tarpaved roads, etc., which have taken the place of the waterbound, macadamized

roads of that date, consequently they could not reckon on the suddenness with which rain finds its way into the sewers and shortly afterwards into the storm-water tanks provided for its reception. If they had foreseen present-day conditions they would have taken them into account when estimating the size of the impounding tank which they recommended.

The volume of sewage and rain water which arrives at urban district outfalls often exceeds six times the dry weather flow long before the water of the stream has increased in volume. There should, therefore, be effective means of arresting settleable solids in the excess flow before the supernatant water is discharged. The commission's method of dealing with this phase of sewage purification is sound, but the size of the impounding tank which they recommended is now too small to meet the changed conditions, and should be increased accordingly.

The actual volume which should be impounded if the commission's laudable object is to be attained is likely to vary with circumstances. Some years ago the author recommended the Birmingham and District Drainage Board to increase the capacity of their storm-water tanks from one-fourth to three-fourths of the daily dry weather flow. In some cases much smaller tanks than this implies may be effective; on the other hand, there are places where it may be wise, not only to exceed the six hours' dry weather flow recommended by the Royal Commission, but to exceed even the 18 hours' flow adopted at Birmingham, for the same reason—viz., that the normal volume of the river into which the Birmingham effluent is discharged is less than half the dry weather flow of sewage.

It may be true to say that the sewage problem has not been solved. Still, much has been done, and public opinion becomes more and more insistent of the employment by local authorities of the best available means of purifying noxious liquor, whether domestic sewage or trade waste, before it enters a stream. They may, for lack of money, procrastinate, but tardy action is not now due to the indifference with which some of our rivers were treated in days gone by.

## Meeting of Central States Section

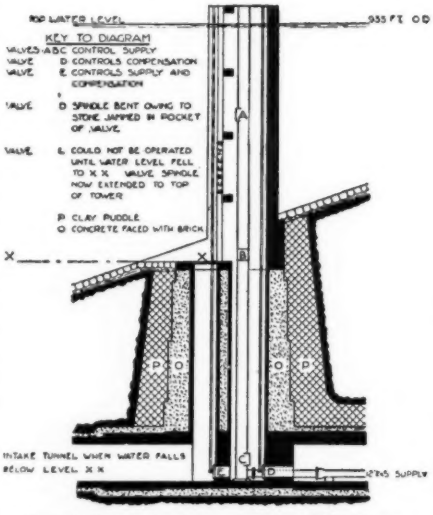
The annual meeting of the Central States Section of the American Water Works Association, was held at Akron, Ohio, September 15th and 16th, 1927.

Mr. E. E. Bankson, Union Bank Bldg., Pittsburgh, Pa., is Secretary.

## Repairing Valves in Reservoir Outlet Tower

A unique piece of repair work undertaken at Dunfermline, Scotland, in 1925, was described in a paper presented June 3 at the annual meeting of the Scottish District of the Institution of Municipal and County Engineers by R. Muir Morton, Burgh Surveyor of Dunfermline.

Ten years ago two valves in the draw-off tower had been thrown out of action, thus rendering it impossible in the first instance to draw water from a lower level than 30 ft. below top water level, while in the second case the compensation valve could not be closed. This serious difficulty at the time was got over by dropping bags of sand inside the valve tower, which,


KEY TO DIAGRAM
VALVES A B C CONTROL SUPPLY
VALVE D CONTROLS COMPENSATION
VALVE E CONTROLS SUPPLY AND COMPENSATION
VALVE D SPINDLE BENT OWING TO STONE JAMMED IN POCKET OF VALVE
VALVE E COULD NOT BE OPERATED UNTIL WATER LEVEL FELL TO X X VALVE SPINDLE NOW EXTENDED TO TOP OF TOWER
P CLAY PUDDLE
O CONCRETE FACED WITH BRICK
INTAKE TUNNEL WHEN WATER FALLS BELOW LEVEL X X
SUPPLY

**Longitudinal Section of Draw-Off Tower, Glensherup Reservoir.**

fortunately, proved effective in partially cutting off the compensation supply. This accomplished, a pipe with valve control was inserted and concreted into the mouth of the compensation outlet, the pipe being afterwards led through the tunnel in the embankment to the compensation weir.

It was not possible, with the total storage capacity available, to risk carrying out the repairs before the county council could afford a supply from a new reservoir at Glendevon. The burn was first by-passed and the supply to the town continued until just before reaching the 30-ft. level already referred to. The county supply was was then turned on to the burgh. The services of a diver were requisitioned, and he found on examination that the set pin holding in position the under collar of the threaded spindle controlling the 60-ft. deep valve had been sheared, thus allowing the bridge to become separated from the spindle. By careful manoeuvring the diver managed to re-enter the screw, and after great effort the valve was opened. In case of the compensation valve he found that a stone had become jammed in the gate of the valve, and the spindle had buckled by the undue pressure applied while endeavouring to close the valve in 1916. As soon as the diver had rendered it possible to operate the 60-ft. draw-off valve, scour valves in the trunk main were opened and the water run to waste.

The reservoir was soon emptied. These operations covered a period of 65 days. The valve spindles and guides were renewed, and the original cast-iron screws on the spindles were replaced in gunmetal. The whole of the ironwork was scraped and coated with bituminous paint. The complete work of emptying and repairing took ten days. The supply to the town was turned on 16 weeks from date of diverting burn.

## Iowa Water Works Meeting

The next meeting of the Iowa Section of the American Water Works Association will be held at the Hotel Chieftain in Council Bluffs September 28, 29 and 30. Mr. J. Chris Jensen, of the Board of Trustees of the Council Bluffs City Water Works will be in charge of the local arrangements. The following are now officers of the Iowa Section: Mr. J. W. McEvoy, Superintendent of Water Works, Dubuque, Iowa, Chairman; Mr. Thomas J. Skinker, City Water Department, St. Louis, Missouri, Vice Chairman; Mr. W. Scott Johnson, State Sanitary Engineer, State Department of Health, Jefferson City, Missouri; and Mr. John W. Pray, Superintendent of Water Works, Fort Dodge, Iowa, Directors. Jack J. Hinman, Jr., is Secretary-Treasurer of the Section. Arrangements are being made to provide facilities for those who wish to have exhibits at the meeting. Requests for space should be sent to Mr. J. Chris Jensen at the Council Bluffs City Water Works.

It is planned that a feature of the meeting will be a discussion of topics of the manual which the Standardization Council of the American Water Works Association hopes to revise within the next year.

## Last of London's Old Waterworks on Sale

If any one wants a relic of the old London Bridge waterworks, where four wheels raised water which for generations was hawked through the streets, they can bid for No. 7 Broken Wharf, Upper Thames street, which was once the pumping station.

The water works were discontinued more than a century ago. The old engine house, which is now empty and up for disposal, has been used as a storehouse. The rental in 1604 was ten shillings or $2.40 a year.

# Stone Bases for Roads

## Suggestions on Their Construction to Meet Modern Traffic Conditions Given in Paper Presented June 13 Before Louisiana Engineering Society

By RODMAN WILEY
Vice-President and Sales Manager, Kentucky Rock Asphalt Co.; Formerly State Highway Engineer of Kentucky

As you are aware, traffic conditions have changed greatly in the last few years, yet today we are building macadam roads and stone bases the same way they were built 15 years ago. As a general proposition, the type does not prove satisfactory and, in my opinion, it is not the fault of the stone base, but the fault of the engineers designing and building it.

Recently, some real thought has been given to the design of broken stone bases; this, with particular reference to lateral displacement and subgrade conditions. It is my opinion that the principal failures of macadam and other types of stone bases are due to the fact that the voids have not been properly filled. This results in internal wear, causing an uneven surface.

In all the discussion that follows I am taking it for granted that drainage and unusual subgrade conditions will receive proper attention.

**Base Laid in Thin Courses.**—I suggest that a broken stone base be laid in thin courses so that the voids can be filled. The first course should be laid not over 4 in. loose, the stone shaped to the proper cross-section of the road and lightly rolled. I do not believe the roller should pass over it more than twice before screenings (¾ in. to dust) are applied and broomed in. All visible voids should be filled, then roll once or twice. Again apply screenings, broom and roll. Repeat this operation until the voids remain filled after thorough rolling. By lightly rolling and spreading the stone in such a thin layer the screenings, under the action of a roller, will shake down through the course of stone and thoroughly fill all voids; but if a thicker layer is spread, or if the stone is keyed too much before screenings are applied, the result will be that the course of stone is only checked for a depth of 1 or 2 in. below the surface, leaving the stone in the lower part of the course free to move.

This course should be lightly watered, but in no event with enough water to saturate the subgrade.

It is important that the stone and screenings be dry, otherwise it will be impossible for the screenings to sift down and fill the voids.

The second and third courses should be built as outlined for the first, except that the last course should be waterbound. The road should then be closed to traffic three or four days to allow it to dry. Excess screenings should be broomed off and the top laid.

It has been my experience that if the stone is spread in thin courses and care used in rolling, it is an easy matter to completely fill the voids and this will result in a rigid base, one that will remain smooth for all time.

This msthod of construction is no more expensive to the contractor than the method now used, except more screenings are required.

The average portable crusher will not, as a general proposition, make sufficient screenings, but this can be met by putting in a machine that will make screenings or else ship in desired quantity.

The thickness of such a base to carry modern day traffic must be left to the judgment of the experienced engineer.

A great many of us who have actually built roads in the capacity of contractors believe that greater stability is obtained when the first two courses are laid in one season and traffic allowed to pass over the base during the winter. The weak places that develop can be corrected in the spring and the top course laid.

**Modified Telford Base.**—The modified telford base came into some favor a few years ago. This was perhaps because of the wonderful service received from telford bases built throughout the country, especially in Kentucky, between the years of 1810 and 1838. There are today in existence in Kentucky many sections of telford base laid 80 to 100 years ago. Such sections have been unprotected by a proper wearing course of stone or by any water-proofing material, yet they have withstood the action of traffic—have supported the loads. It is true, the work was done with a great deal of care and this was possible because of the cheapness of labor in those days. It does prove that design and details of construction really count—results in a worth while structure.

We know that some men will use the same amount of stone as that used by others under identical conditions, yet some roads are better than others. This shows the importance of details of construction.

There has been some dissatisfaction with the modified telford base in the last few years because of the fact that the surface would in a few years become uneven. Again I must say that I do not believe it is the fault of the type, but rather that it is due to faulty design and construction. The stone should, of course, be set shingle fashion, the idea being to break joint, the greatest dimension side of the stone set on the ground. The course should be about 8 in. in thickness and especial care should be taken to get the stone as near to ideal shape as possible. But the principal idea is to have each stone 8 in. in depth after knocking off the tops. Do not have some stone 8 in. deep—some 5 in., etc., and attempt to bring to proper thickness with spalls in an effort to use all stone shot down in the quarry. The fine pieces which are easily knocked off with a hammer will serve to chink and level up the course.

After knocking off the tops, the voids should be thoroughly filled with some very fine material. The idea in using a fine material is to be certain it will sift through for the full depth of the course and completely fill the voids. It is best construction to do most of the void filling before very much rolling. In order to insure even compression some fine stone should then be spread on top of the telford to properly even up the rough surface. Then roll until the course is well compacted. Apply more screenings, lightly water and roll.

Next apply a levelling course about 3 in. compacted. Fill the voids with screenings and water-bind. I think that if a base of this type is properly constructed it is one of the best types to build.

If greater depth is needed, add another course of stone and water-bind.

There are many sections of the country where sandstone and other soft stone can be found in abundance and I am sure that it can be used economically for a base under some kind of an asphalt top.

I have merely discussed the waterbound macadam and the modified telford base. It is believed that these types cover the general field. All others will be modifications, made necessary to suit some local conditions. The main thing, regardless of type or size of the stone, is to fill all the voids.

We should study soil conditions and design each section of the road according to supporting power of the soil and loads that must be carried, just the same as we study these things when designing a bridge abutment or pier. It is rank foolishness to arbitrarily build the base the same thickness and type for the entire length of the road.

**Reconstruction.**—There are now over our country a great many old roads surfaced with macadam and gravel where the alignment, drainage, etc., is good and about all that is needed is to strengthen the base and add a bituminous top.

It is little short of criminal not to conserve the present investment in the surfacing. Good engineering naturally implies conservation, not destruction.

I think the best construction is to dig a trench across the road the width of a shovel at many places and measure the depth of the present base. For the purpose of calculating the amount of new material to use—consider the present base 50 per cent of its real depth. In other words, if the base measures 6 in., value it at 3 in. The reason for this is the fact that the old metal is filled with dirt and other foreign materials and certainly should not

be given a much greater value as compared to new stone and new gravel.

It has been my experience that the best way to proceed with such construction is to fill the hones, ruts, etc., in the present surface with stone or gravel —lightly scarify the surface and properly shape it with a grader.

There may be some question as to scarifying, but it is believed best to do this, especially if less than 4 in. compacted new material is to be added.

By filling the holes before scarifying, the weak places will be properly strengthened. If the holes are not filled before scarifying, it is my experience that the depressions will follow the base to the surface because very fine material will be dragged into the low places when the road is shaped with a grader and there is no stability to the fine material dragged into the holes.

After the surface is properly shaped, new material can be added for a sufficient depth to make a stable base.

## Industrial Notes

**Lynn B. McKnight,** who for the past eight years was associated with the Dodge Manufacturing Company of Mishawaka, Ind., in various sales capacities, has been appointed sales manager of the Stearns Conveyor Company of Cleveland, manufacturers of Stearns Belt Company and Silo Storage Systems. Mr. McKnight was with the Dodge Manufacturing Corp. from 1919 to 1921 at their home office in Mishawaka, Ind., and in 1921 was sent to the San Francisco office to take charge of the Pacific Coast for Dodge. In 1923 he was made sales manager of the Cleveland and Pittsburgh district. Mr. McKnight is a graduate of the School of Mechanical Engineering of Purdue University, Lafayette, Ind., 1915.

The Stearns Conveyor Co., manufacturers of belt conveyors, is owned by Chain Belt Company of Milwaukee.

**The Waukesha Motor Company,** manufacturers of heavy duty Ricardo Head industrial and vehicle engines, have opened their new eastern sales office at 8 West 40th Street, New York City. This office was formerly in the Aeolian Building, 33 W. 42nd Street.

**The Industrial Works,** Bay City, Mich., manufacturers of shovels, cranes and draglines, equipped with crawler or rail mountings, announces the closing of their district office formerly located at 823 South Oregon Avenue, **Tampa, Fla.,** effective immediately. The district office at Atlanta, Ga., located in the Hurt Building, that city, will handle all of Florida, Alabama, Georgia, North Carolina, South Carolina and the eastern portion of Tennessee.

**Harnischfeger Corporation,** factory and home office at Milwaukee, Wis., recently exported eleven of their latest model excavators to Cuba. These eleven machines are now working on the longest paved highway ever covered by a single contract. The Central Cuban Highway will extend almost the full length of the island, passing through the provinces of Pinar Del Rio, Havana, Matanzas, Santa Clara, Camaguey and Santiago. This long highway will be paved with Warrenite Bitulithic, a product manufactured by Warren Brothers Company, the principal contractors on the job. P&H machines are being used exclusively, and many dragline, shovel, clamshell and skimmer scoop attachments were purchased by the contractors with which to meet every requirement in connection with highway construction work.

It is estimated that an expenditure of $75,-840,000 is involved in financing this extensive project. The finished paved highway will be more than 700 miles long. Carlos Miguel De Cespedes, Secretary of Public Works, has pledged its completion in 1931. In addition to the eleven P&H excavators employed on the Central Cuban Highway, the Cuban Government has purchased four machines with which to carry on a program of municipal and port improvements.

**Splitdorf Electrical Co.** have recently appointed the following service stations: H. A. Kennedy, Larned, Kan.; Blount's Electric Service, Market Street at Sixth, Washington, N. C.; Roy C. Bradley, 371 East 4th Street, San Bernardino, Cal.; Fullerton Auto Electric Co., 140 West Commonwealth Avenue, Fullerton, Cal.; Cheatum Electric Co., Liberal, Kan.

**The Willamette Equipment Company** of Portland, Ore., are now authorized representatives of the Galion Iron Works and Mfg. Company, for the state of Oregon.

They will handle the complete Galion line of road graders, road rollers, motor graders and other road building and maintenance equipment.

The sale of the New Galion Leaning Wheel E-Z Lift graders and Galion McCormick-Deering E-Z Lift motor graders will receive special attention and with other machines will be stocked at Portland.

A good supply of Galion tough, hard alloy steel grader blades will also be carried in stock by them to fit practically all makes and sizes of graders in use in Oregon.

This progressive concern is very well known in their territory and are looking forward to a large business in Galion Road Machinery.

**Harnischfeger Sales Corporation** of Milwaukee announces that due to increased volume of business it has become necessary to make the following additions in the sales department of their organization: Mr. R. S. Breyman, Mr. M. A. Germond, Mr. D. Graze, Mr. Deane S. Holt and Mr. J. C. Yetter.

**W. H. Williams** has been added to the Splitdorf Electrical Co. field service division. Mr. Williams is at present traveling Pennsylvania and adjacent states calling on Splitdorf service stations, branches, highway departments, agents and distributors of manufacturers using Splitdorf automotive equipment. Announcement of the appointment was made by L. E. Farine, manager of the Splitdorf products service.

**Mr. R. P. Shimman,** of the Link Belt Company, has been appointed assistant to the chairman and the president, and will, hereafter, make his headquarters at 910 S. Michigan Ave., Chicago, the general offices of the company.

**Mr. Frank B. Caldwell** has been appointed sales manager of the same concern, with headquarters at the Chicago plant office, 300 W. Pershing Road, and will have supervision over all sales activities in the Western Division.

**William Ogden,** better known to his many friends as "Bill," who has been associated with the Lakewood Engineering Company for the last five years, has left that company to become the manager of the State Highways Division of The Austin-Western Road Machinery Co. of Chicago.

**G. F. Schlesinger,** Director of Highways and Public Works, State of Ohio, announces the appointment of Mr. Fred E. Swineford of Akron, Ohio, as chief engineer of the Bureau of Maintenance of the Division of Highways effective July 1, 1927, succeeding Mr. George E. Carr, resigned. Mr. Carr has not definitely decided his future employment although he is considering several attractive offers.

Mr. Swineford has been division engineer of Division No. 4 with headquarters at Ravenna, Ohio, since July, 1923. Prior to that time he was employed in the department as assistant resident engineer. He is a graduate of Ohio State University with a degree of civil engineer in 1915.

Mr. Swineford will be succeeded as division engineer in Division No. 4 by Mr. L. A. Breen who at the present time is assistant division engineer at Ravenna. Mr. Breen has been connected wth the Highway Department since March, 1916. He received his college education at the University of Akron.

These appointments are in line with the fixed policy of the department to promote employees in service whenever justified by their record in the department.

**C. W. Hall,** formerly manager of the Lansing distributing branch of the Olds Motor Works and later with the Reo Motor Car Company, has joined the sales department of the Duplex Truck Company of Lansing, Michigan.

**The Selden Truck Corp.,** Rochester, N. Y., manufacturers of Selden Motor Trucks, have announced the following new dealers:

Southern California
H. G. Pendell, Inc., 1253 So. Hoover St., Los Angeles.

Philadelphia and Vicinity
G. G. White, 1523 Brandywine Ave., Philadelphia.

Hagerstown, Md., and Vicinity
Wood's Auto Service Co., 805 Pennsylvania Ave., Hagerstown.

Newburgh, N. Y., and Vicinity
Harcourt Motor Co., 245 Broadway, Newburgh, N. Y.

Ohio
Thomas Hillman, Mansfield, Ohio.
W. E. Ellis, Findlay, Ohio.

The same concern has appointed W. L. Poffinberger, of Bellevue, Ohio, as district representative in Northern Ohio, while C. M. Thorpe, with headquarters at Standard Supply & Equipment Co., has been appointed district sales manager for Selden Trucks in Philadelphia and surrounding territory.

## New Trade Publications

**Dragline Buckets.**—The Blaw-Knox Company, 601 Farmers Bank Building, Pittsburgh, Pa., in a folder recently issued, describes a new dragline bucket that they now manufacture. This is the bucket that was on display at the Road Show last spring. The bucket that was on display, according to the folder, was purchased by a prominent Chicago contractor, and has since then been working on a 30-B Bucyrus crane, equipped with a 45 ft. boom, digging an artificial lake for the new zoo at Riverside, Ill. This 1¼ yd. bucket, it is said, is giving a good account of itself. Other sizes, from ⅓ yd. to 2 yd. capacity, are now available.

**Graders.**—The Wehr Company, of Milwaukee, Wis., manufacturers of a one-man Fordson-powered grader, have just sent out an interesting leaflet, on one side of which is described the grader, while the reverse bears an interesting poem by W. H. Burns, County Commissioner of Gem County, Idaho, bewailing the fate of the county commissioner.

**Steel Posts.**—The Sweet's Steel Company of Williamsport, Penn., has just issued a new booklet describing their complete line of Herculean Special Flanged Leg Channel Section and Herculean Steel Posts. The booklet is profusely illustrated with steel post adaptations for fences of every description, sign posts for highway markers, road intersections, etc.

**Power Shovels.**—The Speeder Machinery Corporation, of Cedar Rapids, Iowa, manufacturers of the Speeder one-half yard convertible shovel, have issued a new 32-page catalog showing many cases in which this machine has been used as a power shovel, crane, dragline, skimmer, or trench pull-shovel, handling all types of digging. Not only are these installation pictures worth examination, but the catalog contains full data and specifications of the machine as well, and such information is assembled in a way that should prove helpful to the prospective purchaser.

**Power Shovels.**—The Thew Shovel Co., of Lorain, Ohio, describe, in a recently issued circular, their Lorain 75, equipped as shovel, crane, and dragline, telling by word and by photograph how the machine so equipped has been used by contractors on many jobs. Prominent among the work shown is a big dirt moving job in Texas where the dump wagons used on the job held but one dragline bucket full of dirt.

**Graders.**—The Austin Manufacturing Co., Chicago, Ill., have just issued an interesting circular describing their leaning wheel graders equipped with the telescopic axle feature. A new complete catalog has also been issued that shows the same equipment in greater detail.

## New Books

**Bridge Architecture;** by Wilbur J. Watson, C.E., A.S.C.E.; William Helburn, Inc., 15 E. 55th St., New York City, Publishers; 11x14, 288 pages, 213 illustrations, 66 pages of explanation and history of structures, together with biographies, etc. Edition limited to 1500 copies, board covers. $17.50.

The purpose of this interesting book is to illustrate the art of good bridge design, both as to composition and detail, as exemplified by ancient and modern bridges, illustrating the principles by means of a wealth of carefully selected photographs. Over two hundred illustrations, most of which are full page plates, are classified according to period and for modern bridges, into types. The text includes descriptions of many of the bridges illustrated, some historical data, and considerable literary and legendary lore, all of which should prove interesting to the engineer and the architect. Technical terms have been avoided as much as possible. This book, illustrating as it does many good designs of past centuries and of today's engineers, has a definite inspirational value for the man who is as interested in the architectural design of his bridges as he is in the engineering design of the structure.